Edinburgh Health Society.

HEALTH LECTURES

FOR THE PEOPLE.

FIRST, SECOND, THIRD, AND FOURTH SERIES.

Edinburgh:
MACNIVEN AND WALLACE.
1885.

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PREFACE.

THE feeling that very much of the suffering and weak health which is so apparent in all classes might be prevented if there were an effort made to spread knowledge of the laws of Health, led to the delivery of the following Course of Lectures. That the want of knowledge on the subject, and the necessity for it, was recognised, has been made quite clear by the interest which the lectures excited, and the success which attended the whole scheme.

These lectures were published as they were delivered, but it seemed desirable to present them in a collected form, so that they might be studied by those who wished to do so in reference to their bearing one upon another.

In commending the study of health to every one, old or young, I wish to notice some objections which are urged

against it, with what, at first sight, seems to be a show of reason, viz., that to become concerned about Health is apt to foster fanciful anxieties, and to lead to valetudinarianism; and that there is something unworthy, or at least trivial, in caring for the body. But these are objections which cannot stand a scrutiny. We are bound to know and obey the laws of God, not as they concern part of our being, but the whole, and the better we know the laws which govern us, the fewer will be the vague terrors which will assail us. It is only darkness and ignorance that can terrify.

A little reflection also on the relative values of things will teach us when we must be careful of, and when we must ignore, the body. The body is the means by which we work and think, and if the necessary amount of food, rest, air, and exercise are taken, energy is liberated in the form of good work or wise thought. If more than is necessary is taken, if the body is indulged, the happy moment of development never comes, and dull work and dull thought make Jack as dull a boy as would ever "all work and no play."

Self-denial is the law of development; it is the detaching ourselves, with a pang it may be, but with free will, from the grasp of the lower, and the passing into the guidance of the

higher desire. Comfort there must be—comfort for the comfortless—but wise self-restraint for the comfortable.

The oldest record of man's history tells of a fall in condition from pure greediness of desire. God knows what was lost in those early days, but the last, divinest Teacher of the world struck again the key-note sounded by divine wisdom at Creation, and declared that through self-denial alone we should reach not simply Health, but Immortal Life.

F. E. M. T.

EDINBURGH, 11*th February* 1881.

CONTENTS.

CARE OF THE BODY.

By Professor FLEEMING JENKIN.

Professor Fleeming Jenkin, in delivering the first of a Course of Lectures on Health, in the Watt Institute, on the evening of Saturday, the 20th November, said:—

I cannot suppose I have been chosen to deliver this Introductory Lecture because I have any special knowledge of the body; I rather apprehend that it is because I have shown that I consider the Care of the Body to be a duty, and a very important duty. So far as I have been able to do anything up to the present time, I am afraid that my efforts have been of very little use, except to those who are well-to-do—who are rich. To-night, I feel it a very great privilege, that I am enabled to say something which, I trust, may be of benefit to the poor; and it is to the poorer among you that I am about to address myself to-night.

The first proposition which I lay down is this—and it lies at the root of the whole Course of Lectures which is to be delivered here—it is, That the Care of our Body is a Duty. Many amongst you may think it is very unnecessary that this should be insisted upon, but I am not so sure of that. There is a certain number of people who think that it is rather a selfish thing to take care of our own bodies; that it is a noble thing to take care of our mind, but that we may neglect the body while doing this. They think that it is a still more noble thing to take care of our souls, but sometimes think we can better take care of our souls if we mortify the body. I think both these propositions are

complete fallacies. In all our work we make use, and must make use, of our body; and it seems to me utterly absurd to suppose that when that instrument is out of order we can better perform any of the functions for which it is adapted. Therefore I think that it is our duty to take care of our bodies. We can neither work, nor study to right advantage, if our body is out of order; and when I come to our moral nature, I find something more to say. I wish to point out to you, that if our health is not good, we are subject to special temptations in consequence of the imperfection of that health. When we are ill, we are especially liable to be out of temper. We are especially liable to seek for some relief by means which are not the best; sometimes by drink, sometimes by other forms of indulgence, of which we can hardly approve. What is, after all, our highest duty, or may I say, our complete duty? Our complete duty is certainly to love our neighbour, and to love God. Now, I think that in certain states of health it is very difficult indeed to love our neighbour. If we are thoroughly out of temper, that feeling of kindness becomes almost impossible. And so with the second duty. Just let us ask ourselves for a moment what we mean, when we say that we should love God. I don't wish to preach, but surely one can hardly love God without feeling a certain satisfaction, a certain contentment, in the world, and a recognition of the beauty that is all around us. Is it possible for us when out of health to have that feeling? I do not say that it is impossible for a sick person to love God; it certainly is not impossible, but I venture to say that if you are out of health, you are under much greater temptation than when you are in health; that you will then find it very much more difficult to fulfil those two great duties which sum up all others, than when you are in good health, and therefore it is your duty to avoid running into temptation; if you wilfully sacrifice your health, you do run into temptation. I quite admit that at the last our actions, however much hampered by bodily infirmity, will be judged mercifully, but that is no reason why those who can take care of their bodies should not do so. Now, that care is not selfish. Some people think that taking care of their bodies is

selfish, but my impression is that the selfishness is utterly on the other side; that when people neglect to take care of their bodies, it is from indifference and ignorance that they do it. My impression is, that idleness, indifference, and ignorance, are selfish, and therefore that there is little selfishness in taking care of our bodies, even if we are only looking after ourselves. There is little heroism in running needless risks.

Let me take a case. The child of a Princess was suffering from diphtheria. The Princess took no precaution, and, with a certain heroism, kissed the child, caught the disease, and died. Now, did that Princess do her duty? I venture to think not. It is the duty of a mother to take care of her own health, for the sake of all those to whom she is dear; and, like all other duties, it calls for heroism, and for heroism of a higher kind, not to give way to the impulse of the moment. We could not but admire the Princess for what she did, but precisely because her action commands our admiration; on that very ground, I venture to say that it was not the truest duty that could have been performed under such circumstances.

I have taken the strongest case I could find against my proposition, because the sympathies of all will be for the mother. If we, then, owe this duty to ourselves, to look after our own bodies, how much more do we owe the duty to others to take care of their health? We all know that we must take care of the minds and of the souls of our children, but we must also take care of their bodies, for all those arguments I have used with reference to ourselves apply with tenfold force to those under our charge.

There are many ways in which this can be done, even by the poorest—choice of nourishment, the amount of sleep, the air they breathe, danger from infection;—all these things can be looked after to some extent by all, and it is the duty of all when they know what to do, to do it. Fresh knowledge imposes fresh duties, and no one who attends the course to be delivered here, will go away without having been subjected to fresh duties. When they *know*, then they must *do*, and that is the reason why I ask you to come here.

Now, not only have we duties to our own families, but we have duties to strangers also, and these duties can be performed not only by the rich, but also, to a very great extent, by the poor. It is possible by a very little carelessness, by what may seem very pardonable carelessness, to spread infectious disease. Now that carelessness is not pardonable. When you come to understand how these infectious diseases are spread, it will become your duty then, at considerable self-sacrifice, to take no part in so spreading these diseases. There are certain illnesses, such as scarlet fever and diphtheria, which are spread by means of milk. It is incredible how slight a connection with a source of disease is necessary in order to render that milk thoroughly deadly poison. It may become your duty to sacrifice your wages rather than have any part whatever in meddling with that milk. You have all heard of the good Samaritan. He did not take care of either the mind or the soul of the sick man; he took care of the body. The poorest among you may have the opportunity of taking care of your neighbour's health. You will act as the good Samaritan acted if at any sacrifice of your own convenience you refrain from acts tending to spread infectious disease. The milk distributer who is exposed to infection must say to his master—"I cannot any longer distribute this milk because I would be spreading disease, or you must see that I am thoroughly disinfected; otherwise I must for a time give up my employment."

There is also the duty of being cheerfully obedient to all those laws which are passed with the object of preventing the spread of infection. Thus you should submit, and cheerfully submit, to inspection. We have a system of inspection already in Edinburgh, but I wish we had more of it. You should show a submission, and a cheerful submission, to having your children and yourselves properly vaccinated. Further, there is a duty calling upon you for active interference—the duty of making complaints regarding any nuisances that may exist in your district. Lastly, you have political duties connected with this subject—you should support by your votes those who take an active interest in sanitary matters.

It may, however, be said, that we do not know anything at all

about the matter, that we who set up as authorities are but as "the blind leading the blind." This is but one of the forms of want of faith in those gifts and powers which God has given to man to know things, and by means of that knowledge to combat all these evils. A man that has faith believes that good is possible, that progress is possible, that duties do exist, and that to some extent we can perform them, that we can know what to do, and how to do it, and therefore the man of faith works. The man who has no faith doubts whether there is any good or not. If he is certain of anything, he is certain that those who pretend to know do not know. The consequence is, that the man without faith is idle and indifferent, and therefore what I am preaching is to give you faith; and these lectures ought to give you a reasonable faith in the possibility of action, and in the reality of our knowledge.

It is proved by actual experience that external circumstances have a very great influence upon man's health. Under proper sanitary conditions the death rate ought to be no more than 12 or 13 per 1000, but in this town, which is a fairly healthy town, the annual death rate is somewhere about 21 or 22 per 1000. In Dublin, I am told that the death rate is 40. Half these lives, then, are simply sacrificed by imperfect, by bad, conditions of health. And when I say 40 out of every 1000 die, I ought, taking into consideration the greater number who die among the poorer classes, to say, for certain poor districts of the town, 50 or 60; so that three times more people die in certain parts of Dublin than might do under more favourable conditions. At Hampstead the death rate is only 13; and in New Zealand it is only about 12. Then, taking the case of children. In a certain part of London, where they are well cared for, they die at the rate of 8 per 1000, while in the poorer streets they die at the rate of 30 per 1000. In Geneva, in the sixteenth century, when little attention was paid to sanitary matters, the probability of life when a child was born was only five years. No child could count upon living more than five years; but in the eighteenth century, when a little more had been done, it rose to 27½ as the probability of life, and

this was simply due to external circumstances. High death rates are no doubt due to conditions which cannot all be removed, but they are also partly due to the ignorance that prevails on these matters, and which can be removed. Therefore it is impossible to say that attention to these things is useless.

Now the present lectures are intended to show the poor what they themselves can do to render the conditions of life more favourable. It is the duty of the town authorities, and one to which they are by no means blind, to make the conditions of life better from year to year; but, as the Lord Provost has said, a great part of their pains must be thrown away unless you all co-operate.

Dr Russell will come first, and say what may be done by a judicious selection and preparation of food. Of course we all know that the poor cannot command as good food as the rich; but many of us know that a great difference can be made as to healthy and unhealthy food, by attention to circumstances that seem extremely minute. Dr Russell may tell you when to drink water, and in what quantities. He may tell you that coffee or tea taken with meat is a bad thing; and that food eaten when we are breathless, or hurriedly swallowed, is prejudicial to health. He will tell you of different kinds of food of equal price, but some of which are more nourishing than others—a very necessary thing for the poorer classes to know. He will tell you as to the different modes of cooking food, and that pleasant food does not mean gluttony but good nourishment. He will speak of nutritious foods, such as Indian corn, and maize, against which a prejudice exists. I myself remember the famine in Ireland, when I was a boy; a prejudice then existed against Indian corn—an unfounded prejudice, which still, I suspect, exists in this country at the present day.

Dr Foulis will follow, with a lecture on "Blood and its Circulation." He will speak of cuts, of injuries to varicose veins, and to the arteries. He will tell you what healthy blood means, and what it does. He will show how to secure healthy blood in children, so that they may escape rickets and malformations; and

he will show you the actual circulation of the blood by means of very beautiful apparatus.

Dr Wilson will lecture on "The Lungs." He will speak of the action of the air on the lungs, the kidneys, and the skin. He will say what pure air is, and how bad air acts. He will show how fresh air may be introduced into a poor house without producing draughts. There is a distinct scientific connection between the want of oxygen in the air and a desire for drink. Sleeping with an insufficient supply of air in a bed-room tends to produce consumption. In Vienna there were two prisons managed by the same authorities, and indeed there was no difference between them, so far as the evidence goes, except that the one was well ventilated and the other not. The result was, that six times as many died from consumption in the one as in the other. From day to day we get fresh facts bearing out this general conclusion, that want of fresh air tends to produce consumption. It is well known that in the ill-built Highland cottages consumption is exceedingly rare. Some of the proprietors, however, improved the dwellings, and the death rate from consumption rose as soon as good windows and good walls were built. The people slept in close air, and the death rate from consumption immediately increased among the same population. There is no scientific fact better established than the connection between consumption and want of fresh air. I do not, however, ask you to believe that draughts are good, and it will be the duty of the lecturer to show how to avoid them.

Dr Annandale will lecture on "Accidents and Wounds." He will show that good health lessens the bad effects of accidents, and will give simple rules for emergencies and for nursing. He will also say when it would be best to take an injured person to the Hospital, and when it would be best for him to be taken to his own home.

Dr Angus Macdonald has not sent me any notes of his lecture. It is, however, clear that a lecture treating specially of women's health ought to be one of the most valuable of the series. Women often fall into permanent ill health from ignorance of very simple matters, as when, and how far, to walk; how to avoid the

dangers of overstraining when lifting a patient in bed. Those who are about to become mothers are often ignorant of many dangers which they run.

Dr Underhill will follow with a lecture on "Children," and will speak of such matters as when, and how, to wean a child, of the food to be given at different ages, of sleep, of warmth, and of clothing. It is clear that there are many things which rich and poor have yet to learn on this subject.

Dr Macadam will lecture upon "Water." Now water is a great vehicle for the spread of infection. There is a whole class of diseases habitually spread and communicated by means of water. What the protections are that you can all take, will be explained to you by Dr Macadam. I observe that he is going to speak of the abuse as well as the use of water. You may ask, How can water be abused? and I will tell you one mode, Simply by allowing it to run to waste. The best method of supplying water is that known as the constant supply, by which the water is drawn direct from the mains without exposing it for a single instant in a cistern to the risk of infection. But what is the great difficulty in the way of the introduction of that system? Simply that people have not intelligence enough not to allow the water to run to waste. Therefore it is the duty of all people to prevent the waste of water, and to use it intelligently.

Professor Fraser will lecture on "The Use and Abuse of Stimulants—Alcohol and Tobacco." I know nothing about this subject, and therefore I will say nothing about it; but I am perfectly convinced of its great importance.

Dr Smart will follow, with a lecture on "Preventable Diseases and their Causes;" and in connection with that subject will speak of the spread of disease by means of milk, water, air, clothes, and so forth. He will also explain the objects of registration of disease.

These lectures, if well prepared, well attended, and well followed, cannot but have a good effect, and it is the duty of all who can to attend them. Those who attend must put in practice what they then learn.

I will now speak of what the *law* will do to help you; but to obtain that help you must co-operate with the authorities, and use the facilities which the law has given you. For instance, it is the duty of the Medical Officer of Health and of his Staff in this town, to prevent overcrowding; but how can he do that unless some one complains? Make that complaint whenever a difficulty arises, and not only for rooms in which you have to live, but if you know that on the stair in which you live there is overcrowding, it is your duty to give the necessary notice. It is the duty of the Medical Officer of Health to remove accumulations of rubbish, which are invariably dangerous. It is the duty of the officers of the town to see that persons suffering from infectious disease shall cause no danger to dwellers in a house; to cause dead bodies to be buried before they become offensive; to disinfect rooms which have been occupied by persons with an infectious disease; and to see that defects in drainage and water supply be remedied; but to enable these provisions of the law to be put in force, you must give notice that the occasion has arisen. Do not be afraid of complaining; and if you are not well received by the officers, go to headquarters. You have your Town Councillors, who will be happy to see that your complaint is attended to. The assistance you will obtain from the town is not a charity. It is a right.

Doctors and medicine can always be had. They can be got from any of the Dispensaries in town—the Royal Public Dispensary, the New Town Dispensary, the Missionary Dispensary, the Fountainbridge Dispensary, and the Grove Street Dispensary. In all cases of illness you should call in a doctor; and in sending for him be careful to give your address in full. Dr Littlejohn tells me that cases are sometimes not attended to from a difficulty in finding out the correct address, for medical students with a large number of cases on their hands have not time to hunt about for the particular door in a long common stair. It is no doubt difficult to give a full address in a common stair in which a number of families live, but give it as fully as you can. And I take this opportunity of suggesting that some plan should be

introduced of numbering or lettering the doors in a common stair, so as to enable doctors and others to find out at once the persons sought.

In concluding, I wish to combat indifference and idleness under two very specious forms. I will call these two forms sins —two presumptuous sins. These two sins are, unfounded trust in one's self, and unwarranted trust in Providence. You will meet everywhere, men and women who are guilty of the first of these two sins. They say that they disbelieve that there is such a thing as infection, that they never catch diseases; they say they understand all about drains, and do not want anybody to teach them. As to going into an ill ventilated room, they say that gas never does them any harm; that they know what is wrong better than the doctors; that vaccination is dangerous; that science is rubbish; and as for eating and drinking, they will eat and drink what they like, when they like, and how they like. There are women who dress in ways which are extremely unhealthy, who will neglect all warnings in such important matters as their behaviour during child-bearing. There are women who think they know by instinct how to manage children, and do not need to be taught anything about it; who know by instinct how to nurse, or who know of some old woman or other who will give much better instruction on the subject of health than any doctor. These are not people to be followed.

Science is not infallible, but you may be certain that those who address you here have at least had a good training; you may follow their advice with a good conscience. It is presumptuous to take the responsibility of dispensing with proper guides as to the care of the body, both your own and that of others; use your judgment and self-reliance in choosing your guides; avoid false guides, avoid quacks, avoid people who are ignorant, and who have any motive to mislead.

Now, to come to the other form of sin, what is commonly called, and utterly miscalled, trust in Providence. When a person says, "Oh! disease comes from above;" I quite admit that all disease comes from above, but those who say they trust in Pro-

vidence, very often make use of that expression merely as an excuse for their own idleness. They will not take the trouble to learn; they remain ignorant. They will not trouble themselves to take any precautions, or to apply remedies. They seek for no improvement, and they simply excuse themselves with a completely lame excuse, by saying they trust in Providence. They do nothing of the kind. Where our idleness or indifference will kill or injure others, have we the slightest right to say we trust in Providence? In putting up a scaffolding would you make a loose knot, or put in a rotten plank, and then send men on to the scaffolding, saying you trusted in Providence to make the knot tight and the wood sound? Would you mix poison with your food, and then partake of it, saying you trusted in Providence it would have no ill effect? If you dare to send out tainted milk, which is nothing else than poison, can you say that you trust in Providence it will do no harm?

It is simply untrue, then, when people say they trust in Providence in this way, and I say it is a sin. A doctor in this town told me of an instance where a lady had some children who had just recovered from scarlet fever. They were becoming rather noisy, and she was anxious to get them sent back to school. Accordingly she asked the doctor if she might do so, but the children were just at that stage when there was a considerable risk of their spreading the infection if they came into contact with others, he therefore told her it would be dangerous to send them to school. "But, doctor," she asked, "will my children themselves run any risk of danger?" "Oh, no, the danger is for other people's children." "Oh, then I'll send them back to school to-morrow." Now possibly that lady might be so ignorant that she was not aware of the great risk there was of spreading the disease, but after the warning she received she was committing a grave sin in sending her children to school. What mockery it would have been in her to say, that she expected Providence to protect the other children from the consequences of her selfish act.

We believe that Christianity is an active religion, as much opposed to this blind fatalism, which goes by the name of trust in

Providence, as it is possible to be. I think, and fervently believe, that we must trust in Providence, and that we have nothing else to trust to. But when and how are we to trust in Providence? We must always trust in Providence for the successful application of remedies when we take precautions against the spread of disease, when we eat, and when we drink. We must do all these things with faith in God's laws. Would a soldier in command of a company of troops, and with a wall near him, behind which they might get shelter, ask them to stand in front of that wall, telling them he trusted in Providence they would not be shot by the bullets of the enemy? Why that would be a pure mockery, and a sin against God's laws. The soldier must trust in Providence, the doctor who goes into a fever ward must trust in Providence, after they have done all they can to protect themselves; and so it is with us. After we have used all the faculties which God has given us, then we may boldly trust in His mercy, not expecting miracles to be worked on our behalf, but with a firm confidence in His goodness, as shown in the excellence of all His laws.

FOOD AND DRINK.

By Dr J. A. Russell.

On the evening of Saturday, the 27th November 1880, Dr J. A. Russell delivered the Second of the "Lectures on Health," in the Watt Institute, his subject being "Food and Drink." He said:—

The subject of Food and Drink is one so large, that in a single Lecture I can only hope to give a few leading facts, and to enunciate some principles which may explain those facts, and other facts with which you may be acquainted. Food is required for three chief purposes:—firstly, to replace the losses continually taking place from the body; secondly, to maintain the animal heat, or in other words, to supply warmth—our clothes are only for the purpose of keeping that heat in, and it is from our food that the heat itself is derived; and, thirdly, to supply force for performing work. A man is found to require from one-twenty-sixth to one-twentieth of his weight in solid and liquid food in twenty-four hours, or $\frac{1}{105}$th part of his weight of water-free solids, and by this term is meant solid food, after the proportion of water contained in it has been deducted.

On examining the following table, giving the composition of different kinds of solid food, it will be seen that the majority of them contain much water. If you look, for instance, at even such a dry food as cheese, you will see that it consists of more than one-third of its weight of water.

NUTRITIVE VALUE OF FOODS.—(Letheby.)

Substances, 100 Parts.	Water.	Fibrine Albumen, etc.	Starch, Sugar, etc.	Fat.	Salts.	Carboniferous.	Nitrogenous.	Total Nutriment.
Human Milk, - - -	89	3·5	4·2	3·0	0·2	11·4	3·5	14·9
Cow's Milk, - - -	86	4·5	5·0	4·1	0·7	14·8	4·5	19·3
Skimmed Milk, - - -	87	4·5	5·0	2·7	0·7	11·5	4·5	16·0
Butter Milk, - - -	87	4·5	5·0	0·5	0·7	6·0	4·5	10·5
Beef and Mutton, - -	73	19·0	..	5·0	2·0	12·0	19·0	31·0
Veal, - - - - - -	77	19·0	..	1·0	0·6	2·4	19·0	21·4
Poultry, - - - - -	74	21·0	..	3·0	1·2	7·2	21·0	28·2
Bacon, - - - - -	20	0·8	..	70·0	1·3	168·0	0·8	168·8
Cheese (Cheddar), - -	36	29·0	..	30·0	4·5	72·0	29·0	101·0
,, (Skimmed), - -	44	45·0	..	6·0	5·0	14·4	45·0	69·4
Butter, - - - - -	15	..	..	83·0	2·0	199·0	..	199·0
Eggs, - - - - - -	74	14·0	..	10·5	1·5	25·0	14·0	39·0
White of Egg, - - -	78	20·0	..	..	1·6	..	20·0	20·0
Yolk of Egg, - - -	52	16·0	..	30·0	1·3	72·0	16·0	88·0
White Fish, - - -	78	18·0	..	3·0	1·2	2·4	19·0	21·4
Salmon, - - - - -	78	17·0	..	4·0	1·4	9·6	17·0	26·6
Eel, - - - - - -	80	10·0	..	8·0	1·3	19·2	10·0	29·2
Wheat Flour, - - -	15	11·0	70·0	2·0	1·7	74·8	11·0	85·8
Barley-meal, - - - -	15	10·0	70·0	2·4	2·0	75·8	10·0	85·8
Oat-meal, - - - - -	15	12·6	62·0	6·0	3·0	76·4	12·0	88·4
Rye-meal, - - - - -	15	9·0	66·0	2·0	1·8	70·8	9·0	79·8
Indian-meal, - - -	14	9·0	65·0	8·0	1·7	84·2	9·0	93·2
Rice, - - - - - -	14	7·0	76·0	0·3	0·3	76·7	7·0	83·7
Haricot, - - - - -	19	23·0	45·0	3·0	3·6	52·2	23·0	75·2
Pease, - - - - -	13	22·0	58·0	2·0	3·0	62·8	22·0	84·8
Beans, - - - - -	14	24·0	44·0	1·4	3·6	47·4	24·0	71·4
Lentils, - - - - -	14	29·0	44·0	1·5	2·3	47·6	29·0	76·6
Wheat Bread, - - -	44	9·0	49·0	1·0	2·3	51·4	9·0	60·4
Rye Bread, - - -	48	5·0	46·0	1·0	1·4	48·4	5·3	53·7
Potatoes, - - - - -	74	2·0	23·0	0·2	0·7	23·5	2·0	25·5
Green Vegetables, - -	86	2·0	4·0	0·5	0·7	5·0	2·0	7·0
Arrow-roots, - - -	18	..	82·0	..	..	82·0	..	82·0

In this table the carboniferous matter is calculated as starch; 10 of fat being equal to 24 of starch.

THE SOURCES of food are mainly in the animal and vegetable world. We differ from plants in this respect, that they take up the ultimate elements and build them up into food for themselves, but we require to have them built up into structures of a certain complexity before they are fitted for our nourishment. We are like the bricklayer, who cannot build a wall from the clay of a brick-field, but must have it first shaped and burned into bricks for him. It is possible that in the future we may have the power of building up elements that are just now furnished to us by either the animal or the vegetable world. It is a thing to look

forward to, a thing that I expect our chemists will yet accomplish; so that by synthesis of the ultimate elements they will give us food prepared without the intervention of plants or animals. I can take an article of food and resolve it into its original elements, but it is a different thing to build them up again. For instance, I take this white sugar, which is composed of carbon, or coke, and water. It is easy enough to remove the water from the carbon, by means of this chemical liquid, which has such an affinity for water, that when poured on the sugar it withdraws all the water, and the sugar is converted into a black spongy mass of charcoal. What we desire is, that our chemists shall discover for us how to put coke and water together to make sugar, so that instead of going to the cane-fields of the West Indies, or the beet-fields of France, we may apply for sugar at the nearest coal-mine.

THE ELEMENTS of our food are five in number. WATER.—Man requires from two to four pints a-day of water in addition to the water contained in solid food. ALBUMENOIDS OR ALBUMINATES.—Then we require to have a substance called albumen, or some modification of it. You see an example of pure albumen in the white of an egg; and in every diet which is to sustain life we require to have some substance analogous to the white of an egg. CARBO-HYDRATES.—The third element we require is a portion of a substance analogous to sugar or to starch. These may be called carbo-hydrates. FATS.—Fourthly, fat must be present in some shape or form; and, finally, some SALTS. These elements must be, each and all of them, present in every diet which is to sustain life for a lengthened period. Taking these in detail, as I shall do, and making some remarks upon each, we can look at the sources from which we get them.

ALBUMENOIDS OR ALBUMINATES.—By referring to the table we see that albumenoids are present in salmon, the white of egg, the yolk of egg, and milk. In beef and mutton they are present to the extent of 19 per cent; and you will also see from this table that they are contained in many vegetables, so that we have the sources of the albumenoids both in the animal and vegetable worlds, the

difference being, that in the vegetables, generally speaking, they are not so accessible to us, not so capable of assimilation, and not so digestible. Without further change we can eat the flesh of an animal and be nourished thereby, but it is difficult for us to get albumenoids from vegetables without cooking, while from many it is impossible, even with the aid of cooking, to get them. An animal, however, can extract these albumenoids for us. The ox, for instance, eats grass for us, and converts it into a digestible form, which we can then consume in our own bodies. The ox is furnished with a stomach which enables it to digest woody fibre and cellulose, substances which defy our stomachs. With the aid of cookery we have a very abundant cheap and accessible store of albuminates in the vegetable world

Albumenoids are more easily digested after cooking than before. Some people imagine that the white of an egg is more easily digested in its raw state, but that is not so; if it be swallowed in its ordinary state it is much longer in being digested than when cooked, though if whipped, it is so divided that it affords a large surface for contact with the gastric juice, and it is therefore quickly attacked.

Albumenoid substances are remarkable on account of containing a large proportion of nitrogen in their structure. The others contain no nitrogen; and any substance which does not contain a large amount of nitrogen will not build up the tissues of the body. The special functions of albumenoid substances is to repair the tissues of the body, to build up the body, and subserve the purpose, in some cases, of furnishing animal warmth and the force for work; but for the latter purposes they are wasteful food. When animals are fed on food from which albumenoid substances are totally wanting they rapidly lose substance, and die from what physiologists call nitrogen starvation. At the same time, albumenoid substances alone, or many of them, at all events, are not sufficient for carrying on the functions of the body for any time. Gelatine will not keep a dog alive for any length of time. In fact it dies rather sooner than if starved out and out. The albumenoid substances are digested in the stomach by the gastric juice.

The secretion in the mouth does not contribute much to their digestion, and although it is necessary to chew the albumenoids, the reason of that is to divide them finely, so that they may come into intimate connection with the gastric juice in the stomach. Albuminates cause a quick change and renewal of the tissues of the body, and hence are valuable in great labour.

As the albuminates are the main source of nitrogen, while the carbo-hydrates and fats are the chief sources of carbon required by the body, it is sometimes convenient to estimate diet according to the nitrogen and carbon contained in it—the nitrogen being looked upon as the chief tissue-building element, and the carbon as the force and heat-giving one.

Fats are equally necessary with the albumenoid substances, although they do not directly tend to the upbuilding of the body. The fats are one of the great sources of animal heat and force for work. Their use for producing heat every one knows, from the way in which they are used in the Arctic regions. You all know how the inhabitants of these regions eat fat to a large extent, and eat it in a form which to us would be disgusting. I remember the late Professor Pillans telling how, in his young days, and that will be nearly a hundred years ago, the street lamps used to be extinguished in Leith, through the Russian sailors who came into the town drinking the train oil contained in them. When people have to eat a diet in which fat is deficient, they begin to feel it very soon. In the Zulu war, at the siege of Ekowe, the troops under Colonel Pearson suffered from the want of fat. You may remember seeing a letter in the papers from one of the officers, stating that they attempted to use the grease intended for the waggon wheels, but found it too nauseous.

Fats are very important, not only for affording animal heat and force for work, but also as tending to the assimilation and digestion of the other substances of a diet; and albumenoid substances are not properly digested unless in the presence of fat. Butter is the most agreeable way of taking fat when we have to take it by itself. Butterine or oleomargarine, which is made of mutton suet or lard, mixed with milk to give it the flavour of

butter, is a perfectly wholesome fat, and the only objection to it is, that many unprincipled dealers sell it under the name of butter. If honestly sold, at an appropriate price, under its own name, it would be a most legitimate article of commerce, and one which would be welcomed as affording a good source of fat for the people. Fats are rather hard to digest by themselves, and therefore one easily digested like butter is very valuable. That they assist in the digestion is shown by the administration of cod liver oil in small doses. It is then given, not so much for the sake of the small quantity of fat contained in a teaspoonful of oil, but to promote the digestion and assimilation of other substances. In fact it is sometimes given in cases of stoutness arising from indigestion, in order to make the patient thinner. The late Professor Bennett alleged that the dearness of butter was one of the causes of consumption.

Now fat is contained in a large number of articles of food, as you will see by referring to the table of composition of foods. Human milk, for instance, contains 3 per cent; bacon, 70 per cent; wheat bread, 1 per cent; rye bread, 1 per cent; and potatoes ·2 per cent, being only one-fifth of that in bread.

Carbo-hydrates, such as sugars and starches, are largely contained in vegetable sources of food. They have no nitrogen in them, and therefore are not capable of nourishing the tissues of the body by themselves. Within the body they are changed into fat, and largely assist in the supply of heat and force for work. Arrow-root consists entirely of water and starch. Starch must be cooked in order to be digested, because the covering of cellulose, containing the starch granule, requires to be ruptured, and the digestive ferments, which act more particularly upon starch, cannot take effect until the covering has been broken. Starch is easily digested by the active principle contained in the saliva or spittle, and therefore it is desirable that farinaceous food, containing starch, should be slowly masticated in the mouth, for the purpose of mixing it with the saliva. The active principle contained in the saliva exercises a chemical influence upon starch, which very rapidly changes it into a form of sugar. This action continues

within the stomach for a short time after the starch is swallowed, but the gastric juice stops the action after it has made its way through the mass. As infants, up to the age of seven months, hardly secrete any saliva, when they are crammed with corn flour or other farinaceous food, it means that they are being fed on a substance which they cannot digest. The nurse sometimes tries to help it by putting the food first into her own mouth. The consequence of this improper diet is seen in the high death rate of infants.

The so-called farinaceous foods for infants are usually only flour baked to a light brown colour, and sweetened with sugar. The high temperature ruptures the starch granules, and converts some of the starch into a soluble substance called dextrin. The digestibility of tops and bottoms of loaves is also due to the higher heat rendering the outside more friable, and converting starch, in part, into dextrin. Those are all good for children above seven months of age.

Salts.—You are all aware how necessary common salt is to promote digestion. You may have read how wild animals are caught by placing a piece of rock salt on the ground; the animals soon come up to lick it, and while doing so are captured. Some of you may remember that in Dr Livingstone's account of his travels in Africa, he came to a district where salt was not to be found, and the diet was purely vegetable, and you will recollect that he used to dream of roasts of beef and bowls of milk, because these matters are rich in salts, and people living on them have less need of salts than those living on a purely vegetable diet. Fresh vegetables, and notably potatoes, contain salts, which are necessary to prevent scurvy, and when persons are deprived of fresh vegetables for some time, as on sea voyages, rations of lime-juice are needed to keep up the health.

Balance.—It is necessary that all these elements—albuminates, fats, carbo-hydrates, salts, and water—should be present in certain proportions; that there should be a certain balance between the quantities in which they exist. In fact, where this balance is neglected, you may have indigestion in poor people

from excessive eating. People who cannot afford to buy enough food may suffer indigestion from over-eating; and so it is with rich people who eat some of these constituents to excess in unbalanced food, the result, in another way, being dyspepsia. There is no single article of diet which is perfectly balanced except milk, and this only for growing young people. For old people it contains too much nitrogen, but for young people it contains the exact proportions of the different elements they require. Eggs, perhaps, come next to milk in their approach to a well-balanced diet. The heat-giving elements and salts are perhaps slightly deficient in the egg; warmth being supplied to the growing chick by the body of the incubating fowl, and salts by the gradual solution of the shell. Where people have to live upon an unbalanced food, the quantities that they require to eat in attempting to get the balance are enormous. In reading accounts of sport in America and Africa, you will notice two circumstances—first, the prodigious quantities eaten by the huntsmen when living upon flesh alone; and, second, their continual craving for fat, and rejoicing over fat meat. Dr Rae tells us that he allowed a ration to his men of 8 lbs. in the Arctic exploration, and other accounts are equally astounding. Sir John Ross states that the daily ration of natives of the Arctic regions is 20 lbs. of flesh and blubber. In many of the books in which you read such statements, you find it remarked that it is necessary to eat so largely in order to counteract the cold; but you find that in Africa, where the heat is intense, the same excessive quantities are consumed by people who live upon meat alone. Barrow tells that ten natives ate an ox all but the hind legs in three days, and three Bosjesmen attendants devoured a sheep in less than twenty-four hours; but, however, if we want really to know what a good flesh eater can do, undoubtedly we must go to the Arctic regions. There is something in the cold after all. The Russian Admiral Saritcheff heard of a person who was a great eater, and sent for him in order to give him breakfast. It unfortunately happened that he had already breakfasted, but, nevertheless, the Admiral set him down to a porridge made of rice and butter—3 lbs. of butter and

the remainder of rice, 28 lbs. in all,—and he finished it at one sitting. Biscuits are a luxury to people living on a purely meat diet, for a small quantity gives rest to the weary stomach, toiling under the great load of lean meat which must be eaten to obtain the amount of fat required in the absence of vegetables or other carbonaceous food. Now, what proportion is necessary for subsistence? Here are tables in which you find the proportions of the different constituents for subsistence:—Albumenoids, 2½ oz.; Fats, 1 oz.; Carbo-hydrates, 12 oz.; and Salts, ½ oz.—making 1 lb., or 16 oz. in all, of water-free food.

100 PRISONERS EXCRETE DAILY 71½ lbs. CARBON, AND 4¼ lbs. OF NITROGEN.

To replace this loss—

If they were fed on Bread alone, would need—

380½ lbs. Bread, which contains

4¼ lbs. of Nitrogen, and 128½ lbs. of Carbon.

(Excess of Carbon wasted, 57 lbs.)

If fed on Meat alone, they would need—

354 lbs. Lean Meat, which contains

109¼ lbs. of Nitrogen, and 71½ lbs. of Carbon.

(Excess of Nitrogen, 105 lbs.)

If fed on a Mixed Diet, 256 lbs. would suffice—

200 lbs. Bread contains	60 of Carbon	— 2 of Nitrogen.
60 lbs. Meat (including 12½ lbs. of fat upon it),	12 "	— 2¼ "
	72 "	— 4¼ "

(No Excess or Waste.)

For Hard Labour (raising 10 stone to a height of 10,000 ft.)

ADD

117 lbs. of Bread, or its equivalent, to one of the above Diets.

—*Arranged from* CHAMBERS.

The foregoing shows how very expensive an unbalanced diet may be, as the excess of carbon or of nitrogen is of no use, and is thrown away; indeed, it is worse than useless, for the matter in excess is largely digested and absorbed, and can then only be excreted from the blood by the lungs, skin, or kidneys, which are embarrassed, and liable to injury by it. On the other hand, if not absorbed, it may partially decompose and give rise to illness. In the food of rich people there is generally an excess of nitrogen taken in the form of too much flesh, and the result is gouty diseases; while a diet containing too much carbon, as rice, potatoes, malt liquors, and fat, is more frequently used by the poorer classes, and checks nutrition of muscle, rendering them incapable of prolonged exertion. The body is apt to become stout, the wind short, and the mind inactive. We see the effects of such a diet exhibited in animals in menageries, which frequently die from a diet too carbonaceous. Poor people, by adopting vegetables, which are rich in nitrogen, and combining them with those that are rich in carbon, may get a fair combination without the use of meat. Peas and beans, for instance, are even richer in nitrogen than is meat, while oatmeal combines a large amount of nitrogenous with carbo-hydrate substances. Strasbourg geese show the effect of a purposely unbalanced diet. They are denied exercise, and fed upon a carbonaceous diet in a warm room, until the liver becomes enlarged to the size of that of a man. The geese are then killed, and the livers made into the famous *pâtes.*

The famous Mr Banting reduced his weight in one year from 202 lbs. to 156 lbs., and brought down his girth 12¼ inches, by avoiding food containing sugary and starchy substances, and living chiefly upon meat and other things rich in albuminates.

DIET requires to be modified in accordance with work. A diet which suffices for health during idleness will not suffice under stress of labour. Take the case of the 100 prisoners referred to in the table. If made to perform work on the diet sufficient for quietude, cases of illness, and probably deaths, would very soon occur; and to enable them to do work such as lifting 10 stone

10,000 feet, would require an addition to the diet of 117 lbs. of bread, or its equivalent. A person brought to bare existence diet can undergo no toil, bodily or mental, under the penalty of breaking down.

The proportions necessary for different conditions are seen in the following tables :—

THE AVERAGE DAILY DIET OF MEN IN QUIETUDE.

Albuminates, - - - - - -	2·5	ounces.
Fats, - - - - - -	1·0	„
Carbo-hydrates, - - - - -	12·0	„
Salts, - - - - - -	0·5	„
Total water-free food, - - -	16·0	ounces.

AMOUNT OF OUNCES (AVOIR.) AND TENTHS OF OUNCES FOR MALE ADULTS.—(Playfair.)

	Subsistence Diet—*i.e.*, sufficient for the mechanical force necessary to carry on the internal work of the body.	Diet in quietude.	Adults in full health, but with easy work.	Adults in active work.	Adults in laborious work.
Nitrogenous Substances, -	2·0	2·5	4·02	5·5	6·5
Fat, - - - - - -	0·5	1·0	1·04	2·5	2·5
Starch, - - - - -	12·0	12·0	18·07	20·0	20·0
Mineral Matters, - -	0·5	0·5	0·71	0·9	...
Carbon (total), - - -	6·7	7·4	11·16	13·7	14·3

DIET OF A MAN OF 10 TO 12 STONE WEIGHT, IN MODERATE WORK.

Albuminates, - - - - -	4·587	ounces.
Fats, - - - - -	2·964	„
Carbo-hydrates, - - - -	14·257	„
Salts, - - - - -	1·058	„
Total water-free food, - -	22·866	say 23 ounces.

For laborious work, such as that of the soldier on service, even more is required:—

Albuminates,	6·0	to	7·0	ounces.
Fats,	3·5	to	4·5	„
Carbo-hydrates,	16·0	to	18·0	„
Salts,	1·2	to	1·5	„
Total water-free food,	26·7	to	31·0	ounces.

For harder work than this 35 to 40 ounces of water-free food is needed, or as much as the man can possibly eat, for then it really becomes a race between the stomach and the muscles, and foods like meat, which are rapidly digested and concentrated, become important. The quantity of water required also goes up. We have gained this information by means of very costly national experiments. In the last Arctic Expedition the men were allowed a diet of about 35 ounces, and yet that was not enough for the work to be performed. Estimates of the daily work they accomplished vary from 534 tons lifted one foot to 1000 tons lifted one foot, and the estimated value of the diet was 585 foot tons.

Sir Robert Christison said of the British army in the Crimea, that any person could have foretold as a certain consequence, sooner or later, of their dietary, that the British troops would fall into the calamitous state of health which befell them in the Crimea, the reason being, that they were sent on a diet on which they were living at home doing nothing, into a cold climate, where they had to work very hard indeed; and it cost the country a great many lives and money before the diet was corrected.

In some prisons the work and diet are so exactly balanced that the prisoners lose weight in winter and gain weight in summer. This shows that somewhat more food is required in cold than in warm weather.

Dr Frankland, of London, has experimented upon different kinds of diet as to their force-giving power, and you will see that at the head of the whole list there stands oatmeal.

Weight and Cost of Various Articles of Diet required to Raise a Man (140 lbs.) to the Height of 10,000 Feet.—(Frankland.)

	Price per lb. s. d.	Ozs. required.	Cost. s. d.
Oatmeal, - - - -	0 2¾	20·5	0 3½
Flour, - - - - -	0 2¾	21·0	0 3¾
Peameal, - - - -	0 3¼	21·4	0 4½
Bread, - - - - -	0 2	37·5	0 4¾
Potatoes, - - - -	0 1	81·1	0 5¼
Rice, - - - - -	0 4	21·5	0 5½
Beef-fat, or Dripping, -	0 10	8·9	0 5½
Cheshire Cheese, - -	0 10	18·5	0 11½
Cabbage, - - - -	0 1	192·3	1 0¼
Butter, - - - - -	1 6	11·1	1 0½
Hard Boiled Eggs, - -	0 6½	35·3	1 2½
Lump Sugar, - - -	0 6	24·1	1 3
Milk (per quart), - -	0 5	128·3	1 3½
Lean Beef, - - - -	1 0	56·5	3 6½

The smallest quantity is required for doing the work, and at the same time it is the cheapest in price, 2¾d. per lb. We would require 20½ oz., the total cost being 3½d. It is very closely run by wheat flour, which costs ¼d. more, and ½ oz. more of it would be required. Potatoes are very low, and are expensive when you come to measure the work. 5¼d. worth is needed to do the work that is done by 3½d. worth of oatmeal. The quantity of cabbage required is absolutely ridiculous. A man, to do the work, would require to eat about a stone of cabbage, and who is sufficient for that? Of course it must be understood that this table merely gives the theoretical quantities that would produce the force. It is obviously impossible to digest a stone of cabbage, or five pounds of potatoes in addition to subsistence diet, nor would it be healthy to take large amounts of unbalanced food. Oatmeal and wheat flour have the advantage of being nearly balanced, and with the addition of milk, it would be possible to live on either of them for long periods of hard work.

Great political facts sometimes depend upon dietetics. I heard a celebrated politician and chemist once state that the greatest

blessing that ever befell Ireland was the potato famine, and he explained it in this way. He said, that a diet of potatoes was sufficient to keep life going in idleness, but a man was not capable of digesting such an additional quantity as would enable him to work, and consequently Irishmen, by the very fact of this diet, were compelled to live in idleness. Maize and Indian meal have an advantage over oatmeal in containing more fat. Indian meal has 8 per cent of fat, while oatmeal only contains 6, and ryemeal 2—a fact worth remembering, though maize does require considerable cooking.

Life can be supported by a very minute quantity of food as long as complete inactivity of body is maintained, but under such circumstances the slightest exertion will bring on a fatal result. With vegetable food so cheap as it is in the shape of oatmeal, peas, etc., few people need live upon a bare subsistence diet. Two years ago I was informed that the prisoners in Stafford Gaol had the lowest sick rate and death rate in the country, and yet they were fed on 4½d. per day. Dr Parkes kept a strong soldier doing hard work in perfect health on 1¾ lb. oatmeal and 2 pints of milk daily, at a cost of 5d. for the meal, and 4d. for the milk.

Activity is the natural condition of the young, and they bear starvation much worse than old people. The younger they are the more easily they are starved. Milk is essential to the proper nutrition of the young. Dr Ferguson, the Factory Inspector, by a careful continuous measurement of factory children, found that between thirteen and sixteen years of age they grew four times as fast on milk for breakfast and supper as on tea and coffee.

The excellent and time-honoured porridge of Scotland does not agree with some persons (young and old). When this is the case, it may often be corrected by longer cooking, or by mixing wheat or barley meal with the oatmeal. If it cannot be taken in any form, bread and milk is the best substitute. Young people should have four or five abundant meals per day, of plain food, without stimulants or spices. Strong tea, ham and smoked articles, are not advisable; nor should food be given to children too hot, as this frequently damages their teeth, and it is necessary

to preserve the teeth as long as possible, as aids to digestion. The value of the teeth is not understood till they are lost, and then it is too late. They should never be extracted if the dentist can fill them; and as a common cause of decay is the fermentation of food lying between them, frequent washing and brushing of the teeth is a means of preserving them.

To keep old people in health the diet should be spare, but very digestible, and easy of solution. Their toothless jaws and feeble digestive organs fail to extract nourishment from food that would be very well suited to younger persons.

A word as to the time when food should be taken. For working people who have to do hard manual labour, it is undoubtedly best that some food should be taken before beginning work. Unless the blood contains the means for supplying force, the work is done at the expense of the body. Consequently, when it is possible, the greater portion of the day's food should be taken at breakfast and early dinner. One authority states that 1½ parts of the day's food should be taken at breakfast, two at an early dinner, and one part at the evening meal. No doubt work immediately after a meal interferes with digestion, but this only applies to very hard work, and there is usually an interval of rest. Though children require food often, it is found that digestion proceeds better in the case of grown-up people when they take three, or, for some people, two meals a-day.

COOKING.—By cooking, we prepare our food for digestion, and by it a large amount of vegetable food is placed at the service of man which are quite useless to him in the raw state. 'It is, moreover, chiefly by the same art that he has been enabled to take his food at intervals, in separate meals, and has thereby been for ever relieved of the necessity which is imposed on all animals in the wild state of having to spend almost the entire of their waking hours either in seeking after their food, like the carnivora, or in consuming their food like the vegetable feeders.'

Cooking has a mechanical action by which it ruptures starch cells, disintegrates fibres, and softens the whole food, which is then

easily acted on by the digestive fluids. In addition to this mechanical effect, cooking produces chemical changes of an important kind, as facilitating digestion. Prolonged cooking causes changes in the food which approach very closely to, if they are not identical with, the alterations effected by the action of the digestive fluids themselves; and thus, by the use of fire heat, man is saved a great amount of labour which falls upon the digestive organs of the lower animals.

Another object of cooking is to provide the variety which is so desirable and, indeed, necessary for young people. Even when the food cannot be varied, it is at all events often possible to change the method of cooking it. A varied diet is more digestible and healthier than a monotonous one. While studying variety, it is well to remember that the diet should not be restricted to substances which can be entirely digested and absorbed, but that it is better to have a certain amount of insoluble non-irritating residuum to give bulk, and promote the movements of the alimentary canal. Brown bread should be frequently used as a change from white, but if too coarse the residuum is irritating, and hurries the food along the alimentary canal without giving sufficient time for digestion and absorption. Most vegetables yield a considerable amount of residual matter, and hence a diet abounding in vegetable food, and especially when it contains some of the outer covering of the grain, is used in constipation.

Still another office of cooking is to balance our food, and it is perfectly wonderful how correct popular instinct is in the combinations which it has effected. For instance, animal and vegetable food are taken together; salad with salt meat. Bread, which is deficient in fat, is eaten with butter; bacon with greens, pork with peas-pudding. Peas contain 22 per cent of nitrogenous material, while bacon contains next to none. Peas are poor in fat, having only two per cent, while bacon has 70 per cent; so that by combining the two the excess of the one balances the deficiencies of the other.

Thorough cooking destroys parasites in the food, which might give tape-worm or other diseases to man; and for this reason, as

well as to increase digestibility, meat, especially the meat of the pig, either fresh or as ham, should be completely cooked.

The mode of cooking has such an effect upon the digestibility of the same substance, that it is rather difficult to form a table of precedence in this respect. Two of the following tables are derived from the experiments of Dr Beaumont, who took into his service Alexis St Martin, a Canadian, who at the age of 19 had an opening made into his stomach by the discharge of a gun, and yet lived with the opening unclosed long enough to become the father of a large family, and to allow Dr Beaumont to make many observations on the interior of the stomach, and the effects on food introduced through the opening. Other cases of a similar kind have afforded opportunities to more recent experimenters, and hence the table by Dr Chambers is inserted.

RELATIVE DIGESTIBILITY OF VEGETABLE SUBSTANCES.

Articles of Diet.	How Prepared.	Time of Chemification. H.	M.
Rice, - - - - - - -	Boiled,	1	0
Apples (sweet and mellow), - -	Raw,	1	30
Sago, - - - - - - -	Boiled,	1	45
Tapioca, - - - - - -	Boiled,	2	0
Barley, - - - - - -	Boiled,	2	0
Apples (sour and mellow), - -	Raw,	2	0
Cabbage with vinegar, - - -	Raw,	2	0
Beans, - - - - - - -	Boiled,	2	30
Sponge Cake, - - - - -	Baked,	2	30
Parsnips, - - - - - -	Boiled,	2	30
Potatoes, - - - - - -	Roasted,	2	30
Potatoes, - - - - - -	Baked,	2	33
Apple Dumpling, - - - - -	Boiled,	3	0
Indian Corn Cake, - - - -	Baked,	3	0
Indian Corn Bread, - - - -	Baked,	3	15
Carrot, - - - - - -	Boiled,	3	15
Wheaten Bread, - - - - -	Baked,	3	30
Potatoes, - - - - - -	Boiled,	3	30
Turnips, - - - - - -	Boiled,	3	30
Beets, - - - - - - -	Boiled,	3	45
Cabbage, - - - - - -	Boiled,	4	0

Relative Digestibility of Animal Substances.

Articles of Diet.	How Cooked.	Time of Chemification. H.	M.
Pigs' Feet (soused),	Boiled,	1	0
Tripe (soused),	Boiled,	1	0
Eggs (whipped),	Raw,	1	30
Salmon Trout,	Boiled,	1	30
Venison Steak,	Broiled,	1	30
Brains,	Boiled,	1	45
Ox Liver,	Broiled,	2	0
Cod-fish (cured dry),	Boiled,	2	0
Eggs,	Roasted,	2	15
Turkey,	Boiled,	2	25
Gelatine,	Boiled,	2	30
Goose,	Roasted,	2	30
Pig (Sucking),	Roasted,	2	30
Lamb,	Broiled,	2	30
Chicken,	Fricasseed,	2	45
Beef,	Boiled,	2	45
Beef,	Roasted,	3	0
Mutton,	Boiled,	3	0
Mutton,	Roasted,	3	15
Oysters,	Stewed,	3	30
Cheese,	Raw,	3	30
Eggs,	Hard Boiled,	3	30
Eggs,	Fried,	3	30
Beef,	Fried,	4	0
Fowls,	Boiled,	4	0
Fowls,	Roasted,	4	0
Ducks,	Roasted,	4	0
Cartilage,	Boiled,	4	15
Pork,	Roasted,	5	15
Tendon,	Boiled,	5	30

You will observe that tripe was digested in one hour, and this explains why tripe is a favourite supper dish, as it enables the process of digestion to be finished before going to sleep. Salting meat spoils it very much. The soluble valuable parts are abstracted, and the remainder rendered hard and indigestible.

Table of Precedence in Digestibility of some Articles of Animal Food.—(Chambers.)

Sweetbread and Lambs' Trotters.	Boiled Veal, Rabbit.
Boiled Chicken.	Salmon, Mackerel, Herring, Pilchard, Sprat.
Venison.	Hard Boiled and Fried Eggs.
Lightly Boiled Eggs, New Toasted Cheese.	Wood Pigeon, Hare.
Roast Fowl, Turkey, Partridge, and Pheasant.	Tame Pigeon, Tame Duck, Goose.
Lamb, Wild Duck.	Fried Fish.
Oysters, Periwinkles.	Roast and Boiled Pork.
Omelette (?), Tripe (?).	Heart, Liver, Lights, Milt, and Kidneys of Ox, Swine, and Sheep.
Boiled Sole, Haddock, Skate, Trout, Perch.	Lobsters, Shrimps, Prawns.
Tripe and Chitterlings.	Caviare.
Mutton.	Smoked, Dried, Salt, and Pickled Fish.
Roast Beef.	Crab.
Boiled Beef.	Ripe Old Cheese.
Rump Steak.	
Roast Veal.	

In some of the numerous treatises on health being at present published, and many of which are very expensive in the end, as they take up only a single subject and pad it out to the shilling size, you will find it stated that it is a mistake to take soup before dinner, as it dilutes the gastric juice.* This is incorrect, for two reasons—firstly, because there is no gastric juice to dilute until the secretion is provoked by food; and, secondly, because the soup furnishes to the blood the elements for the formation of the gastric juice that is to digest the food. During fasting the blood is poor in the materials for the formation of gastric juice, and if boiled white of egg be introduced into the stomach of a fasting dog it lies undigested for a long time, owing to want of gastric juice. Hence the practice of taking soluble nitrogenous nourish-

* The best manual of this kind, and one that I heartily recommend, is 'Personal Care of Health,' by the late Dr Parkes. Published by Society for Promoting Christian Knowledge. Price 10d.

ment, such as soup, before dinner, is an excellent one in view of preparing the stomach for what is to follow. To the general statement that food is rendered more digestible by cooking there are a few exceptions. The digestibility of milk is unaffected by boiling, but it is otherwise with the oyster. 'The oyster is almost the only animal substance which we eat habitually, and by preference in the raw or uncooked state; and it is interesting to know that there is sound physiological reason at the bottom of this preference. The fawn-coloured mass which constitutes the dainty of the oyster is its liver, and this is little else than a heap of glycogen. Associated with the glycogen, but withheld from actual contact with it during life, is its appropriate digestive ferment—the hepatic diastase. The mere crushing of the dainty between the teeth brings these two bodies together, and the glycogen is at once digested without other help by its own diastase. The oyster in the uncooked state, or merely warmed, is, in fact, self-digestive. But the advantage of this provision is wholly lost by cooking, for the heat employed immediately destroys the associated ferment, and a cooked oyster has to be digested, like any other food, by the eater's own digestive powers.'

VEGETARIANISM.*—Man can live upon a purely animal or upon a purely vegetable diet, but my judgment is that he can live best upon a mixture of both. When economy has to be studied he should be almost entirely vegetarian, and without doubt many people would enjoy better health if they practised economy in this way. The only obstacle is unfortunately the formidable one, that vegetable food requires a little more time and care in cooking to make it eatable than flesh does, and that to vary a vegetable diet would involve a trifling mental effort, while forethought appears to be abhorrent to those who most require it. Vegetarianism as practised by most so-called vegetarians, involves the large use of

* Mr Clark of the Vegetarian Depot, Greenside Row, has sent me a number of vegetarian publications which I have read, and having procured and tried some of the cereal preparations recommended, I can say that the foods are infinitely better than the arguments for their use.

milk and eggs.* London needle-women were found to be starving upon tea, bread, and bacon, costing 2s. 7d. per week, while Irish labourers were well fed on potatoes, milk, and maize, at a cost of 1s. 9¾d. per week.

Under the head of Drink, I shall not take up Water, which is to form the subject of a separate lecture, but pass at once to say something about stimulants. Depression may arise from bad air or from over-fatigue, or from ill health. Bad air is to be remedied by ventilation, and for bad health a physician should be consulted. Alcoholic stimulants are the worst we can select, speaking generally, for the effects pass off with great rapidity, and leave the depression worse than before. There is no doubt that alcoholic liquors should be abjured by growing people except under medical advice, and for grown-up people the only time that they cannot be proved to do marked harm is when taken largely diluted, along with food, after the day's work is done.

I may refer you to experiments carried on by the late Dr Parkes, at Netley Hospital. He selected three men to be experimented upon—Sergeant-Major Don, Private P. Holz, and Private W. Hutchins. These men volunteered to undergo experiments for a week, in the shape of marches in heavy marching order, carrying a total weight, including the clothes on their persons, of 51 lbs. Dr Parkes states that, 'having breakfasted at six o'clock, they started at seven, and marched 13¼ miles without a halt or refreshment of any kind. This march was accomplished in 4 hours and 20 minutes. After resting for an hour, during which their pulses and temperatures were taken, they received either rum, or extract of meat, or coffee, with, in each case, ten fluid ounces of water. They then marched 4¼ miles, making 17½ in all, and then, after another halt, had a second allowance of the same substance, with the same quantity of water. A march of 3 miles was then made, making 20½ miles. The rate of march was 3·2 miles per hour; the time taken was 8½ hours, of which two were occupied with halts. At the end of the last march the men had their dinner.

* See 'Food Reform Association's Cookery Book,' by Tarrant: worth buying. Price 2d.

The rations were the usual rations, and the same amount of food was taken daily. The marches were continued for six days, so that each man received rum on two days (but not on successive days), meat extract on two days, and coffee on two days.' This was very hard work; so very hard was it, that when they came in on the first day one of them fainted, and Sergeant-Major Don was in such distress that he was warned not to go on with the experiment, but they all persevered to the end of the six days. At the end of the experiments the men were asked to state their candid opinion of the relative value of the three substances during marching, and Sergeant-Major Don said,—'The meat extract is the best to march on, more strength is given by it; about this I have not the slightest doubt. After the extract I prefer the coffee, and I put the rum last for marching.' Private Holz said,—'I prefer the meat extract; it gave me more strength. As regards the coffee, I would put it before the rum, as the effect of the rum went off in two miles, and I felt better after the coffee than after the rum.' Private Hutchins said,—'I prefer the meat extract; it certainly gave me more strength for marching; it does not put a spurt into you for a few miles, but has a lasting effect. . . . I prefer the coffee to the rum because it quenched thirst, and also the rum at the end of a couple of miles left you as bad as before, or even worse, while the coffee had no effect of that kind.' Private Hutchins said also, that after taking his rum he felt as if he could have jumped a five-barred gate, but that at the end of a mile and a-half his feet were dragging like lead.

Tea and coffee are excellent stimulants, and the former, when not exposed to the air too long, contains a volatile oil very stimulating indeed. Tea along with meat is not a good mixture, because the tannin contained in it interferes with the digestion of albumenoid food.

Through the kindness of the Secretary of the United Kingdom and Provident Assurance Company, I am able to provide you with some extraordinary statistics. In that Society there are about 10,000 teetotalers insured, and there are about 20,000 general insurers. Perhaps you know how exceedingly careful Insurance

Companies are about taking persons addicted to excess of drink. They know that it would not pay, and so their medical men and directors are very strict about it. They reject persons who take alcohol in the forenoon, on the ground that if it is by medical advice, they must be too ill for their life to be assurable, and that if it is not by medical advice, they will very soon be too ill to suit the Insurance Company. In this Society to which I have referred it was found in 12 years, that among the teetotalers and the general section, which are kept separate, there was a very marked difference as to the mortality. In the general section it was expected, according to the table, that 2846 persons would die, and you will see how accurate that table is when I state that 2807 did die. The secretary, in his calculations, was on the safe side by 1·4 per cent. Now as to the teetotalers it was expected that 1619 would die, but instead of that there did die 1156, so that in this case he was 463 wrong. In the one case 1·4 per cent did not die, and in the other case the teetotalers refused to die to the extent of 28·5 per cent. In comparing the two classes, however, we must remember that those in the general section are not drunkards, and that the general community who are accepted by the Insurance Offices are not those most likely to take to drink, and include some who are teetotalers in all but the name. I believe a good deal in the poisonous effects of alcohol, but I am not able to credit it with all of this astonishing difference. The explanation, which is satisfactory to my mind, is, that strong and healthy people, likely to live long, are more apt to become teetotalers than those in weaker health. The former feel that they have no need of stimulants, and that it is no sacrifice to take the pledge; the latter feel the need of them, and decline; and so by a process of self-selection the strong man goes to the one side, and the weaker man to the other.

Taking them all in all, soldiers are not teetotalers, but they seem to do better without stimulants. As confirmatory evidence of the good health of teetotalers, I may refer to the Ashantee war. The climate was exceedingly bad, and four out of every six of the soldiers went through the hospital. but of teetotalers only one

out of every six went through it. There are two commanders just now, Sir Garnet Wolsley and Sir Frederick Roberts, neither of whom believe in the issue of a rum ration to the troops. Sir Garnet will not allow it, for the very practical reason, that the army when it is not allowed a ration of spirits will allow itself to be knocked about in any way, and will not grumble, but if allowed a ration of rum the men find every additional duty a grievance, and grumble excessively. In the Red River Expedition in Canada, in which Sir Garnet won his fame, he did not allow them to carry stimulants, and although they performed some extraordinary work, yet the health of the troops was so good, that if it had not been for a few broken bones they might have left the doctors at home. In South Africa it was the same. Where they could not get stimulants they were healthy, and did not enter the hospital, but whenever they came into a land flowing with rum, then they entered the hospital freely.

But people must have some drink, and if rum or beer be not the thing, what is the thing? I believe there is nothing better than a thin gruel, made of well boiled oatmeal, with a little sugar in it, and I state that upon the authority of Dr Parkes and of some eminent railway engineers. I shall take one case, in which a broad gauge railway was being changed into the narrow gauge. To avoid any long interruption of traffic it was desirable to have this change effected as rapidly as possible, and 314 men were put on to the work, which they finished in four days, working almost night and day, and it was then found that this thin oatmeal gruel was the drink that was most successful. The Engineer of the Varna railway, who writes a book on Turkey, mentions, that to encourage the men, who were clearing away a block of snow on the line, he gave them spirits, but found that they knocked up in about a quarter of an hour afterwards, and he then made the discovery that, for continuous work, some other stimulant was necessary. The proportions of the gruel I have mentioned are—$\frac{1}{4}$ lb. of oatmeal in three or four quarts of water, with an ounce of sugar, and well boiled. I recommend this to you, as a good means of quenching thirst, and permitting work to go on.

APPENDIX

CONTAINING

THE PRINCIPAL PRACTICAL POINTS.

Economy.—Flesh meat is expensive, and perfect health may be maintained, and hard work can be done, without it. Taken, however, *once* a day, it forms an agreeable variety, and cannot be said to do harm. Oatmeal, wheat flour, peameal, maize or Indian corn, and many others, supply the place of meat. With these, and rice, milk, potatoes, butter, fat, or oil, and fresh vegetables or fruits, people may be well nourished at small cost. When hard work has to be done with extreme economy nothing equals cooked oatmeal with milk.

Variety.—The material of the principal dish at dinner should be changed often, or it should be cooked in a different way. Monotony in diet is to be avoided, especially for young people.

Eating.—Some food should be taken before work; and the bulk of the day's food taken at breakfast and mid-day dinner, to sustain the body during work; tea dinners are not a good plan. Eat slowly, and chew well, if you wish to live long and escape indigestion and low spirits. *Violent* exercise immediately after food should be avoided. Regularity as to time and quantity is important.

Cooking.—More skill and trouble are required for cooking vegetable food than animal food, for flesh is more nutritious if eaten raw than when cooked, but less digestible. Flesh, and especially pork or ham, should be cooked through and through, to

avoid risk of tape-worm and other parasites. Overcooking is apt to spoil animal food, and undercooking most frequently spoils vegetables. Cook slowly.

Drink.—By far the best drink for heavy work is a quarter of a pound of oatmeal, well boiled in two or three quarts of water, with an ounce or an ounce and a-half of sugar added. Beer or alcoholic drinks should be altogether avoided by growing persons, and should only be taken in a diluted form, with food, after the day's work is done. Even in the case of grown-up people, it is found that teetotalers, as a rule, live longer than moderate drinkers.

Stimulants.—The best stimulant of a ready kind for fatigue is Liebig's Essence of Beef, strong coffee or strong tea comes next to it. Spirits cannot be used if work has still to be done or cold endured, as they merely give a temporary spurt, and the fatigue and depression are then worse than before.

Youth.—The meals should be four or five in the day. The food should be abundant but plain, and without stimulants or spices. Tea, ham and smoked food, are not good. Factory children between thirteen and sixteen years of age were found to grow *four times as fast* on milk for breakfast and supper as on tea and coffee. Food and drink are frequently given to children too hot, and this damages their teeth.

Adult Life.—About twice as much food is required for *very* hard work as for complete idleness, and about once-and-a-half as much for ordinary work. Three meals a-day, and for some people two, are enough. For spurts of exceedingly severe work, during which it is necessary to eat as much as can be digested, it is desirable that the diet should contain a large amount of meat.

Old Age.—The food for old age must be very digestible, but should be small in quantity. Very old people are always spare in their diet.

A FEW WORDS ON LUNGS AND AIR.

By Dr. ANDREW WILSON.

On the evening of Saturday, 4th December, Dr. Andrew Wilson delivered the third of the course of Health Lectures in the Free Assembly Hall, his subject being, "A Few Words on Lungs and Air." Dr. Wilson said :—

Ladies and Gentlemen,—Most of you, I doubt not, are familiar with that incomparable allegory of Addison's, entitled the "Vision of Mirza," who, led by his guide, looks eastward to a great valley through which flows a rapid tide. The valley, his guide informs him, is the Vale of Misery, and the tide of water forms part of that great tide of Eternity which is called Time. Across this shoreless ocean passes a lengthy bridge. At either end the bridge is cloaked in sombre shadow, and the bridge, Mirza is informed, is meant to typify human life. The bridge contains threescore and ten arches, but at its far end, are several arches incomplete and broken. Multitudes throng the bridge, and Mirza is horrified to find that as they pass on their way across its arches, the passengers now and then disappear mysteriously from sight, and fall through trap-doors which lie in the line of their path. The most frequent pitfalls are at the beginning of the bridge and at its end; there are fewer pitfalls in the middle. The parable is one, as you know, of human life. The pitfalls, which are most numerous in the beginning of the bridge of life, represent the diseases or chances of death to which infancy is most subject; and it is natural that towards the close of existence the pitfalls should also again become multiplied. Many important practical lessons may be derived from Addison's allegory, and

especially certain lessons that are intimately connected with the subject upon which I have now the honour of addressing you. The lesson which I think comes very prominently before us, and is taught by a physiological review of the allegory of Mirza is, that while the pitfalls in life's pathway are very numerous, yet science is competent to lessen their number; and I shall try to show you in to-night's lecture that these pitfalls may be lessened by attention to one aspect of life—namely, that which concerns the work of the lungs. There are four important questions which we must consider—firstly, Why we breathe; secondly, How we breathe; thirdly What we breathe; and fourthly, How we may breathe properly. If, therefore, we can satisfactorily answer, in a plain and homely fashion, these four questions, I think we may congratulate ourselves at the close of our task on obtaining a certain amount of information which bears in a very important fashion upon the preservation of health and the prolonging of life.

The first of our four questions is, I think, readily answered. Perhaps, however, you will permit me to say, in no deprecatory spirit, that there exists a complete and wholesale ignorance regarding the subject of breathing. Why our chests should rise and fall sixteen or seventeen times a-minute, is a complete mystery even to persons of culture. That the mere movements of the chest are repeated with singular regularity, that under the influence of emotion they are quickened somewhat, and that they are essential and necessary to life's continuance, we all know; but such information yet leaves unexplained the meaning of the breathing process. If the question were succinctly asked, I repeat, 'Why does the chest rise and fall so regularly?' perhaps no satisfactory answer might be forthcoming. A little reasoning might certainly suggest that air from the atmosphere was inhaled, and that air was likewise given out. But as to the difference between the air which passes into the chest and that which comes out from it; as to the very existence of any difference at all; as to the purpose of the air passing into the chest; or further, as to the reasons for the differences between the air going in and coming out, popular philosophy must own itself to be, as a rule, entirely ignorant. Let

us, therefore, try to answer fully the question, Why do we breathe? Suppose you had a person shut up in the proverbial glass box which is supposed to be a proper fate for certain individuals whom we number among our friends and acquaintances, I presume you will admit that that person must breathe, and must likewise have food. I choose this example because a person shut up in the metaphorical glass box would live apart from all the trouble and anxieties of life, and his body would apparently be completely at rest. His chest, however, would still rise and fall, and you would therefore have to provide him with air, and also with food and drink. What, therefore, is the meaning of Nature's demands, seeing the man is not engaged in his ordinary work, and seeing that he is removed from all the outer cares of the world? A little reflection shows us that the man's body, although in a state of rest, is still working. You cannot stop the beating of the heart, by which blood is propelled through the body. You cannot stop the man from thinking; and therefore, arising from the work of heart and the work of the brain, you will have waste, or wear and tear, which requires to be repaired. We repair that waste by the taking in of matter from the outer world, which matter we term *food.*

Let me ask your attention for a moment to this question of waste; for that is the special point that concerns us at the present time. No living being can even exist or perform the simplest vital acts without entailing waste. You cannot lift an eyelid, you cannot move a finger, your heart cannot beat a single stroke, or your brain think a single thought, without the organ which works in each case exhibiting waste proportionate to its work. If it works much, it wastes much; if it works little, it wastes little. Now, the lungs form one of three organs devoted to the getting rid of these waste matters. These organs are the lungs, skin, and kidneys. One organ is capable to a certain extent of taking on the work of the other, when the latter is injured by disease. Thus, a person suffering from inflammation of the lungs will be treated by the administration of medicines, causing an intense action of the skin,—and why so? The answer is, because physiology has taught the physician that the skin performs much the same kind of work

as the lungs, and that the skin may to a certain extent act as a deputy to the lungs. The lungs may be said, then, to be occupied in the work of *excretion*, or that of getting rid of the natural waste of our bodies, which the work of our frames entails. Then, secondly, lungs may be viewed in another sense, namely, that they supply us with a certain amount of nourishment, namely, the *oxygen* of the air. Food may be either solid food, water, or oxygen. You have to think of the oxygen of the air as material for carrying on the processes of life, just as a beef-steak assists in the renewal of our frames. You may discern then, clearly the position of the lungs in their double relation of "givers out," and "takers in." And what I say of the lungs of man applies to the gills of a fish, mussel, oyster, lobster, or any other animal that breathes in water. Although they are popularly said to "breathe water," they in reality breathe the air that is entangled in the water, and thus may be said to breathe essentially the same air and in essentially the same fashion as man himself.

What waste matters, however, do we give out from our lungs? I think there are seven kinds of waste material into which our bodies are chemically breaking down. There is firstly, Heat. Although heat is necessary of itself for the continuance of our lives, still so much is always being dissipated from our bodies. That may be said to be the surplus of the heat which is required for carrying on the processes of life. Secondly, there is Water, which in some form or another—as watery vapour, or simply as water, is being excreted from the body. Suppose, for instance, that a number of persons are seated in a compartment of a railway carriage. They pull up the windows, in a short time the glass will become obscured by vapour, and, as these persons continue to breathe in the compartment, fluid will trickle in due time down the windows. If a chemist were to analyse that fluid he would tell you that it was pure water. It has been breathed out or "excreted" from our blood by the lungs. Thirdly, there is Carbonic-acid Gas, and of all the matters given out from our lungs, this carbonic acid stands in the first rank. Fourthly, there is Ammonia, a chemical name for a substance identical with that you familiarly call hartshorn.

Fifthly, comes Organic Matter, that is the actual waste matter of the body itself, or our actual bodily particles. There is no matter in the impure or vitiated air of our rooms, which is of more consequence as injurious to health than this organic matter. Sixthly, there is given off a small quantity of Mineral matter; and seventhly, we find amid our waste material a substance called Urea, this latter substance being chiefly given off by the kidneys. Urea is a compound which, if allowed to remain in our blood, causes death by convulsions. If these waste matters, as a whole, be allowed to accumulate in the blood, or, what is of equal importance, if they be rebreathed again or re-enter the system, the consequence may be disease, or even death itself. All three organs—lungs, skin, and kidneys, let us note, get rid of essentially the same things. There is no difference, in kind, between the work of the lungs, the work of the skin, and the work of the kidneys. These seven substances are given off by all three organs, but in different proportions. Which of the substances stand out prominently as the product which the lungs excrete? Firstly, Carbonic Acid; secondly, Watery Vapour; and in the third rank we may place Organic Matter. We have therefore these three things specially to consider in this discourse.

Now, as to the second of our four questions, How do we breathe? This point is of extreme importance; and to properly appreciate the work of the lungs, to understand what the lungs do, you must know where the lungs are. Examining the chest we find the spine or backbone behind; then come twelve pairs of ribs forming a bony cage and meeting the breast-bone in front. Then we have also got a very important muscle called the *midriff* or *diaphragm*, which forms the floor of the chest, this floor being arched. To give you a clear conception of the relations of chest and midriff, suppose the chest to be a room or apartment, and suppose a person to be standing inside that room, then the floor (that is the diaphragm) on which he stood would be arched or curved. Our chest is not a rigid bony cage. On the contrary it is highly elastic; for where the ribs join the breast-bone you have got that elastic material called gristle or cartilage, so that the chest may expand more

readily in breathing. If pressed in a crowd you would find that you are able to sustain great pressure from the front, because of this elasticity, but if you met the pressure with your sides, the chances would be that your ribs would get broken. The chest is thus elastic from the front backwards, but brittle from side to side. What is the use of this muscular diaphragm or midriff? The answer is that it is the muscle which assists us in breathing. A mere child knows you have *inspiration* or breathing in, and *expiration* or breathing out. Inspiration is the act which gives us a considerable deal of trouble, for if you will take in a deep breath, expanding your lungs to the fullest extent, you will find that while the action of breathing in gives us considerable trouble, that of breathing out is very much easier. It seems as if, when in the act of breathing in, you raised your chest to a false or unnatural position, if I might be allowed to use the expression; then, when you let the chest go in the act of breathing out, it seems to return to its natural position easily and without the least effort. How is inspiration performed? By means of the diaphragm. This great arched muscle has the power of contracting. It then grows less arched, but in so doing draws the chest downwards and also enlarges it from side to side, thus increasing the capacity of the chest. Then also there are certain little *intercostal muscles* which lie between each pair of ribs and which assist the diaphragm in the action of enlarging the chest. What then happens to the lungs? The lungs are a pair of elastic bags, having their sides closely applied to the walls of the chest. It therefore follows that when the chest walls move and when the chest enlarges, the lungs expand likewise, and air passes into the chest. When the chest may be said to return into its position of rest, the lungs contract and the air is thus expelled. The act of breathing is then easily understood, when you think of the chest as a movable case containing a pair of elastic bags or lungs which respond to the movements of the cage in which they lie.

Let us now pass to consider the structure of the lungs themselves. In gaining ideas about even complicated things, it is well if we can start with a general idea of a special subject. For

instance, in teaching the physiology of the heart, what is first wanted is a good general idea of what any kind of heart is. You get such an idea by thinking to yourselves of a "hollow muscle;" for the heart is nothing more nor less than a muscle, which is, first of all, hollow to allow blood to pass through it, and which secondly, is a muscle that it may contract to propel the blood. The general idea that I want you to have of the lung in the same way, is that any lung, from that of a frog to that of a man, is simply *a bag of air-cells* or pockets containing air. Look at this diagram. In front of the throat you have a pipe called the windpipe or *trachea*, strengthened by gristly rings, and having the organ of voice or larynx at the top. This windpipe or trachea divides at the root of the neck into two branches or *bronchi*—a main-pipe for the right lung and another main-pipe for the left lung. The lungs, as you see, are two in number, and have the heart lying somewhat obliquely between them. Look at the surface of the lung. It is divided into a great number of small spaces or divisions seen very well on the outside of the lungs. These little divisions are called *lobules*. Each lobule is like all its neighbours, so that if you get an idea of the structure of one little division you understand the whole. Suppose you dissect the lung, what do you find? You find that this windpipe branches out into innumerable divisions, and imitates a tree of small tubes which grow finer and finer the further you pass away from the main divisions of the windpipe. Trace out one of these tubes to its ultimate ramifications, and you find it to end in a cluster of small bags or cells. Suppose a main passage to have a number of little rooms clustered round one end of it in a somewhat circular form, and you get an idea of the ultimate structure of the lungs. In this diagram here, you notice two clusters of things that look like bunches of grapes, and these are really two groups of the air-cells of which the lungs are composed. Let me now ask your attention to the size of these air-cells. They vary in size in different parts of the same lung, but each measures on an average about the $\frac{1}{40}$th part of an inch in diameter. Thus you find that the lung itself, though a large organ (the two lungs weighing about 40 ozs.), is made up of microscopic parts. As to

the colour of the lungs, they are in infancy of a rosy pink hue. But it may be asked, Why do we specify their infantile colour? The answer to that is, that our lungs are not of the same colour throughout life. When we grow older they turn to a grey colour, and sometimes to a dark bluish grey. What is the meaning then of this change? Formerly it was believed that the lungs naturally changed colour. Now, however, we believe that they change colour owing to the substances or matters which are inhaled into them from the outside world. Men who work at trades or in places where a large number of black particles float in the atmosphere have blacker lungs than other people. Colliers, for example, suffer from a disease which is called "colliers' lung," or "black phthisis." It appears to be caused in individuals of a weakly constitution by the irritation set up by the innumerable particles of coal dust breathed into the lungs. The needle grinders of Sheffield, too, were formerly liable to suffer from a disease which got the name of "needle-grinder's lung." It was caused by particles of iron being inhaled and passing into the chest, literally cutting the lungs to pieces. That disease, however, has, I believe, been minimised in Sheffield by the use of magnetised masks which attract the particles, so that they do not pass into the lungs. Our lungs are thus very largely coloured and affected by the particles of matter we inhale. Each lung is covered by a beautifully delicate membrane called the *pleura*, and the sides of the chest are lined with the same membrane. In the movements of breathing the lung does not therefore rub against the side of the chest, but the pleura covering the lung rubs against the pleura lining the chest. A small quantity of fluid is thrown out from the pleura and lubricates the lung in its movements. When the pleura is inflamed we have the affection known as pleurisy, which thus does not, as is supposed by some, mean inflammation of the lungs themselves.

Let us now take a rapid review of the relations of heart and lungs. What do the lungs do? They get rid of waste matters, as I have already said, but we may now inquire as to the sources from which these waste matters are obtained.

I have here a diagram which represents the theory of the circulation. You observe that the pure blood coming from the lungs, passes out from the left side of the heart to nourish the body. That blood soon becomes impure. After it has nourished our body, it acquires from the tissues of the body, a large amount of waste matter. That waste matter is now passed along in the current of blood, is taken up by the veins to the right side of the heart, and thence is passed back to the lungs, there to be purified. So that the lungs are continually giving pure blood to the left side of the heart, while they are as incessantly receiving impure blood from the right side. The lungs resemble a person receiving with one hand, and giving away with the other. What changes does the blood undergo in the lungs? The blood, after passing through the lungs, changes from a dark purple to a light red colour. If we take the dark, venous, or impure blood from a living animal, we may change it into light blood by passing a stream of oxygen gas through it; or if we take the pure, arterial, or light-coloured blood and pass carbonic acid through it, it at once becomes dark-coloured. We thus see that the change in colour is due to the action of these gases. The red blood globules are the oxygen carriers of the blood, and it is in these little bodies that the changes in question take place. The blood in passing through the lungs thus gains oxygen; it loses carbonic acid; becomes 1° or 2° warmer; coagulates or clots sooner; and contains more fibrin.

Let us now inquire in the next instance, how the lungs accomplish their all-important work. We are continually breathing in oxygen, and are as continually giving out carbonic-acid gas. How is it that the exchange is managed? The lungs may be compared to a market-place, where two merchants are met to transact business, or rather to barter—blood representing one merchant, and the atmosphere the other. The blood says to the atmosphere, "If you will give me oxygen, which I require, I will give you carbonic acid." And the atmosphere, on the principle that fair exchange is no robbery, agrees to the exchange. It may be well to remind you here of the use of this carbonic-acid gas. This gas is exceedingly injurious to animals, but every green plant is greedily sucking it

in by day. Carbonic acid is in fact an important constituent of the food of plants. In this fact we have an instance of that wise ordering of Nature's laws and rules whereby no waste is permitted in her dominions. What is a waste product in one kingdom is utilised for the nutrition of the other; carbonic-acid gas, useless and dangerous to the animal, becomes part of the food of the plant world. As to the manner of exchange of the two gases in the lungs, that is a matter of chemistry, or rather of natural philosophy, inasmuch as you find that where two gases of different densities are separated by a thin membrane, it is a law of Nature that they tend to change places. Thus blood containing carbonic-acid gas is brought to the lungs, and the air containing oxygen passes into the air-cells. The blood contained in the network of vessels outside these cells will part with its carbonic-acid gas, which, through the law of diffusion of gases, then passes into the lungs to be breathed out. The oxygen in its turn, passes in the reverse direction, through the thin walls of the blood-vessels and air-cells into the blood.

A word now about the amount of air necessary for a single breath, before I proceed to the topic of ventilation. Remember that by the deepest breath it is impossible to exhaust the lungs of air. The teachings of natural philosophy fully account for this fact. Suppose you had an empty space inside your chest, the chest would be in danger of being crushed in by the air from the outside. We live under an equal pressure of air from all sides. The outward air presses on the body to the extent of about 15 lbs. to the square inch. We do not feel this pressure, because it is perfectly an equal on every side. The air inside requires, for our physical safety, to press outwards, with the same pressure that the air outside is pressing inwards. The air remaining in the lungs over and above the deepest expiration is named by physiologists, *residual air*. How much residual air remains in the lungs of a man of average height after breathing out? The answer is, that it is ordinarily calculated at 100 cubic inches. What amount of air (*tidal* air) do we take into, and put out of, our lungs without any extraordinary exertion? About three-quarters of a pint, or from 20 to 30 cubic inches. You may thus be said to have in your lungs 130

cubic inches, but in a deep inspiration you draw in another 100 inches; therefore in a full breath you will take in about 230 cubic inches of air. Mr. Hutchinson of London made a number of researches in order to ascertain the *vital capacity* of the lungs. Without giving you the details through which he arrived at his conclusions, I may say that for a person 5 feet 7 inches high, the vital capacity is said to be about 225 cubic inches—this being the ordinary amount of air which a man of that height can take comfortably into his lungs, taking the temperature of the outer air at 60° Fahr. With another inch in height—that is, 5 feet 8 inches—you would have to add 8 cubic inches to indicate the vital capacity of the lungs. If the person were an inch lower, you would have to subtract 8 cubic inches from his standard of vital capacity. Last of all, remember that the work which is done by the muscles in breathing—by the diaphragm, the muscles of the ribs, and other muscles—represents in twenty-four hours a considerable amount of work. When physiologists calculate the amount of work done in living beings, they take as their standard the force that is required to lift one ton weight one foot high, and that amount of force is called a foot ton. We may be astonished when we discover that by actual calculation, the work of the respiratory muscles has been estimated to amount to twenty-one foot tons in twenty-four hours.

Our third question was, "What do we breathe?" If you could breathe absolutely pure air, you would breathe a mixture of two gases, oxygen and nitrogen. Air is not a *chemical* compound, but a mere mechanical mixture. We may roughly say that in 100 volumes of air, twenty-one volumes of oxygen exist to every seventy-nine volumes of nitrogen. Nitrogen has no action whatever in the animal economy. Its use appears to be that of diluting the oxygen. Notice that you also get in the air, carbonic acid—(about three or four parts in 10,000 of air); watery vapour, varying according to the state of the atmosphere; a little ammonia; a gas called ozone, which is just another and much more subtle form of oxygen; and also nitrous and nitric acids. The oxygen has an all-important part to play, but the nitrogen, I repeat, appears to serve merely for dilution. In the year 1774, oxygen gas was dis-

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covered by Priestley, the famous chemist, and it was also in that year that the composition of air itself was discovered by Lavoisier, a French chemist.

After being breathed, the air, first, becomes warmer. Suppose you take air at an ordinary temperature, that is to say, 60° F., then the air which goes out of our lungs is between 97° and 99° F.—that is nearly the heat of the blood. Secondly, the carbonic acid of the expired air is increased; thirdly, its oxygen is diminished. But here you should be particular to note that we do not say it is all carbonic acid, or that it contains no oxygen. Fourthly, the expired air has its watery vapour increased; and fifthly, it contains ammonia and organic matters, which, as we have seen, come out of the blood.

What amount of air then is required for ordinary healthy breathing in the course of twenty-four hours? An adult at rest will breathe 686,000 cubic inches, or from 350 to 400 cubic feet of air in twenty-four hours. But a hard-working labourer, on the other hand, will breathe 1,568,390 cubic inches in the same period of time. Thus you see the difference in the work of respiration which increased muscular exertion invariably entails. We require a certain cubic space for healthy breathing, and so far as one individual is concerned, he should have a space of 1000 feet—that is to say, a room ten feet square and ten feet high should be inhabited by one individual alone. What amount of air, however, would be required to pass through that room in the course of an hour? The answer to this query is that 3000 cubic feet of air per hour must pass through that room for healthy breathing. You require for an hour's breathing three times the amount of air the room will hold at any one time. The average healthy adult consumes of oxygen, 10,000 grains in twenty-four hours. He produces 12,000 grains of carbonic acid in that time, and of water, nearly nine ounces. Suppose 2000 persons to be congregated, as we are, in a large building, and suppose these persons to sit in that building for two hours—the ordinary duration of a meeting, What amount of water, representing the waste matter of the body, would be exhaled by the skin and lungs together in these two

hours? The answer is, seventeen gallons of water; and the amount of carbonic-acid gas which would come forth from the 2000 pairs of lungs contains as much carbon as could be extracted from one hundredweight of coals. You see how very material are the products and quantities of waste substances which are given forth from the lungs; and you see how literally enormous is the quantity of waste matter which is given out by human beings congregated together.

Now, as to the last question, How may we properly breathe? There are three items to be considered in the regulation of breathing—namely, carbonic-acid gas; organic matters, which are equally dangerous; and watery vapour, which is not quite such a bugbear as the two former items. I am afraid that to many "carbonic acid" is the mere name of a gas which can assume no importance unless they are brought face to face with it in a rather sensational and startling fashion. Carbonic acid, firstly, kills animal life when breathed in sufficient quantity. Carbonic acid was responsible for the death of 123 out of 146 persons immured in the year 1756 in the "Black Hole" of Calcutta through the cruelty of a foreign despot. That room was only eighteen feet square; it was lighted and aired only by a small window three feet square. The result was that the children died off in a few hours, suffocated by the impure air; women, also, soon succumbed; and of the miserable remnant of twenty-three that issued forth in the morning, many were afterwards cut off by the putrid fever engendered by the vicissitudes of that fearful night. Again, on the 1st of December, 1848, the steamer *Londonderry* was crossing the Irish Channel. A severe storm coming on, the 150 passengers being ordered down below, the hatches were battened down—of these persons, seventy were suffocated by carbonic-acid gas. It is carbonic acid which is responsible for sleepless nights in badly-ventilated bedrooms; it is carbonic acid which is responsible for cutting off a large number of the children of the poor through inducing early lung-disease; it is carbonic acid which, along with the exhaled organic matter, produces typhus fever; it is carbonic acid which is responsible for the somnolence of people

in church—so that persons very much concerned in church affairs, and very much interested in the oratorical reputation of their clergymen, should see that the ventilation of their churches is perfectly carried out.

But carbonic acid is capable of inducing actual disease, even if it does not always kill us outright. I take the following instances from the work of Dr. Andrew Combe on the "Principles of Physiology"—a book which forms a richer repository of interesting physiological facts than any other book I know. Here is first an interesting story about the poet Crabbe:—"When ten or eleven years of age, he was sent to a school at Bungay. Soon after his arrival he had a very narrow escape. He and several of his school-fellows were punished for playing at soldiers, by being put into a large dog-kennel, known by the name of the 'Black Hole.' George was the first that entered; and the place being crammed full of offenders, the atmosphere soon became pestilentially close. The poor boy in vain shrieked that he was about to be suffocated. At last, in despair, he bit the lad next him violently in the hand. 'Crabbe is dying; Crabbe is dying,' roared the sufferer; and the sentinel at length opened the door, and allowed the boys to rush out into the air. My father* said, 'A minute more, and I must have died.'" Another instance is quoted by Combe from "Walpole's Letters." "A parcel of drunken constables took it into their heads to arrest everybody they met, and thurst them into St. Martin's Round-house. Five or six-and-twenty persons were thus shut up all night with closed doors and windows. In the morning four were found suffocated for want of air, two died shortly after, and a dozen more were 'in a shocking way.'" "A similar but less tragical case," says Combe, "occurred at Tain in Ross-shire, where several persons arrested for rioting were almost suffocated by being confined in a small closet that had been used as the safe of a bank." These instances show us the great power which this carbonic acid has upon animal life to affect it injuriously.

Let me now show you to what extent carbonic acid exists in

* Combe is quoting from Crabbe's Memoirs, written by the Poet's Son.

various situations. I have here a table of statistics compiled in 1864 by Dr. Angus Smith, and bear in mind that the normal amount of carbonic-acid gas in pure air is about 3 parts in every 10,000 parts of air. In the Chancery Court on 3rd March, 1864, 7 feet from the ground, the doors being closed, there were 19·3 parts of carbonic acid, and in the same Court, on the same day, at 3 feet from the ground, there were 20·3 parts of carbonic acid; while with open doors there were only 5·0 parts of that gas —that is to say, on 3rd March, 1864, the administration of justice in one Court in London was carried out amongst such a prevalence of carbonic acid, as I make bold to say, could neither have been good for judge, jury, nor counsel engaged therein. In the Strand Theatre, one of the smallest in London, in the gallery at 10 P.M., there were 10·1 parts of carbonic acid. In the Surrey Theatre, one of the largest, there were in the boxes at 10 P.M., 11·1 parts, and at 12 P.M. there, the carbonic acid had risen to 21·8. In the pit of the Standard Theatre, at 11 P.M., there were 32·0 parts of carbonic acid. If, I repeat, three volumes of carbonic acid in 10,000 of air form the normal quantity, you can understand how deleterious an atmosphere existed in the pit of the Standard Theatre, where the amount stood at 32·0 parts of carbonic acid in 10,000 of air. In the Queen's Ward of St. Thomas' Hospital, at 3.25 P.M., there were 4·0 parts of carbonic acid, and in Edward's Ward at 3.30 P.M., there were 5·2 parts in 10,000 of air. In Lambeth Workhouse wards there was only ·1 part; in St. Luke's, Chelsea, 7·6 parts, and the same proportion in East London (Homerton). You can thus note how carbonic acid rises wherever human beings congregate together and where the means of ventilation are inefficient. Turning to this other table you may notice that carbonic acid increases in towns over the amount exhibited in country districts. In Scotland at the summit of the hills in November, 1869, it stood at 3·32 measures in 10,000 of air, and at the foot, at 3·41. In the different postal districts of London, it ranged from 4·115 in the western and west-central districts to 4·745 in the eastern and east-central districts. In Perth and suburbs carbonic acid was

present in the proportion of 4·136 in 10,000 of air; in the closest parts of Glasgow, 5·39, and in the more open parts of that city, 4·61; in Manchester, 4·42; in that city during fogs, 6·79; about Manchester middens ("of which there are thousands," says Dr. Smith), 7·74. We see that the carbonic acid rises very materially where you have decomposing organic matter contaminating the air. Lastly, where the fields begin near Manchester the carbonic acid was only 3·69. The air of Manchester contains 17 to 20 times as much organic matter as the Forest of Chamouni or the Hospice of St. Bernard. The rain of Glasgow carries down a thousand times more organic matter than the rain of the adjacent west coast. The air of Dundee, Galashiels, Glasgow, and Greenock contains 6 to 9 times as much organic matter as that of Edinburgh; and London and Manchester 3 to 5 times as much organic matter as our own atmosphere. We may, therefore, I think, as citizens of Modern Athens, congratulate ourselves upon the comparative purity of the air—though I may add that this purity is not due to our own efforts to make it pure, but largely to the prevailing winds.*

A man expires in twenty-four hours, about 19 cubic feet of carbonic-acid gas. The breath which comes from his lungs has lost 5 per cent. of oxygen; it gained five per cent. of carbonic acid, and that breath will not sustain life for any length of time, if rebreathed. He poisons nearly 16 cubic feet of air per hour, or 380 cubic feet in twenty-four hours. Of water he gives off 9 to 10 ounces from his lungs in twenty-four hours. The organic matter accumulates in the air to a dangerous extent long before the carbonic acid makes itself felt. This organic matter which appears to be a breeding medium for typhus fever, is promoted by want of ventilation and by the insanitary conditions of our houses. We can breath

* Analysis of the air of various localities reveals startling results in even the *comparative* quantities of organic matter present. Thus in the atmosphere of a close house the amount of organic matter is stated as 60·7; in an uncovered pigstye at 109·7; in warm weather in London streets, 29·2. Contrast with these numbers the organic matter in purer situations: Hospice of St. Bernard, 2·8; Lake of Lucerne, 1·4; open air sixty miles from Yarmouth, 3·3.

air mixed with $\frac{1}{50}$th its bulk of pure carbonic acid; but add organic matter and we can only tolerate $\frac{1}{200}$th of carbonic acid in the atmosphere.

The effects of tolerance in connection with bad ventilation are extremely well noticed both in the animal world and in ourselves. Claude Bernard made the following interesting experiment. He placed a sparrow under an air-tight glass of such a size that the bird would live without the admission of fresh air for three hours. At the end of the second hour, however, a fresh sparrow was put in its place, and immediately died. The air in which the first sparrow would have survived for another hour, was so vitiated that it killed the second sparrow directly it was introduced into that medium. The effects of bad ventilation are well shown in the case of two prisons in Vienna which, I think, Professor Fleeming Jenkin mentioned in his introductory lecture. Between 1834 and 1847, in the prison of the Leopoldstadt, which was badly ventilated, the mortality went up to the high rate of 86 per 1000—51·4 per 1000 of these deaths being due to consumption. The House of Correction in Vienna was, however well ventilated, and the deaths there were only 14 per 1000, of which only 7·9 were from consumption, so that there was a balance of 43·5 deaths per 1000, due practically to foul air. Then in the cattle plague in 1866, the difference between well and ill-ventilated byres was easily seen in the number of deaths occurring in them. There were fewer deaths in draughty byres, through which a constant current of air was passing, than in those model byres where the ventilation had not duly been attended to.

As to the amount of air which it is necessary to supply each person with per *hour*, I may refer you to a table, which shows that in hospitals for ordinary patients you must give each person 2000 to 2400 cubic feet; in hospitals for epidemics, 5000 cubic feet; in work-shops—ordinary trades, 2000 cubic feet; in unhealthy trades, 3500 cubic feet; in prisons, 1700 cubic feet—that is because life in a prison is regulated automatically, and therefore you may do with less frequent renewal of air; in theatres, 1400 to 1700 cubic feet; in meeting halls, 1000 to 2000 cubic feet; in

schools for children, 400 to 500 cubic feet; and in schools for adults, 800 to 1000 cubic feet. Dr. De Chaumont says that those numbers, large as they seem, are too small, and that where ventilation can be carried out beyond those figures it should be done. The effects of lights in rendering the air impure must also be noted. Two hard sperm candles, or one oil lamp, consume as much oxygen and give out as much carbonic acid as one man; therefore, a man sitting in a room with two candles requires twice as much air as he does by day. One gas burner consumes as much oxygen, and gives out as much carbonic acid as four or five men; so that, not only have we to think of ourselves in ventilation, but also of ventilation relatively to the use of gas and other lights.

What form of ventilation, last of all, can be carried out in our ordinary houses? Here let me remark, that in addressing you on the question of ventilation, it is needful to bear in mind that we cannot afford to pull down our houses and reconstruct them on sanitary principles. Too frequently, advice concerning ventilation is given on the absurd basis that everybody can rebuild his domicile in accordance with the most recent architectural and sanitary improvements. What I have to say about ventilation shall be said shortly and simply as applying to the houses of rich and poor alike, and as exhibiting easy ways of attaining, with some measure of success, an important end. Firstly, then, every room should have a fire-place to begin with; and secondly, the damper of the grate should be continually up. The fire-place is the natural ventilating shaft of our houses, as these houses now stand. I shall be told in all probability that if I counsel every person to sleep with their bed-room window drawn down from the top, the mortality from consumption will immediately rise; for there are too many people in this world abnormally afraid of draughts. In many cases I would say by all means prefer the draught and the cold, to the chances of disease from bad ventilation. Every window, then, should be pulled down (even an inch or two will suffice) from the top. Here is another plan of ventilation applicable to the houses of rich and poor alike. Raise the lower sash of the window, say three inches, and insert a block of wood of that

depth from side to side of the frame, so that the sash when drawn down will rest upon it. The result will be that the upper end of the lower sash is raised above the lower end of the upper sash to the extent of three inches, so that you have a current of air passing through between the two sashes in an upward direction. This current may be deflected upwards to the roof by a sloping board or by a plate of glass placed on the upper sash.

There is also M'Kinnell's system,* which is adapted for rooms such as halls where you get direct access to outer air. Here you have two tubes, one inside the other, and both opening into the air through the roof. The heated air escapes through the inner tube, and fresh air enters by the outer tube, and is made to pass along the ceiling of the room by an inside edge at the bottom of the tube. Then there are Cooper's ventilators, Sherringham's valve, and Arnott's valve. Lastly, remember that no house should be ventilated from a common stair, which is simply a large shaft sucking up impurities. Ventilate your houses directly from the outer air; and I may add that the cupola or top light of a common stair should always be open so as to admit of the escape of air, whilst at the same time protecting the stair from direct draughts or wet. I may mention that the character of the air in a room may be readily tested by taking a clean glass stoppered 10 oz. bottle, and by stuffing into it a cloth on entering the room. By rapidly withdrawing this cloth, the air of the room enters the bottle. Then, by adding a tablespoonful of clear lime water, and shaking the bottle violently, the air may be tested. If pure, the lime water will remain clear; if the air be foul, the lime water will become turbid or milky in appearance—owing to the carbonic acid of the air forming *chalk* by uniting with the lime of the lime water. We should certainly see that in constructing our houses the wise words of Lord Bacon are remembered:—"Houses are built to live in, and not to look on; therefore let use be preferred before uniformity, except where both may be had."

In closing this lecture, let me briefly remind you of Mirza's vision, and the application of the parable with which I commenced

* These various systems of ventilation were illustrated by explanatory drawings.

my discourse. Mirza looked upon a scene which parallels extremely well what Mr. Darwin would call "a struggle for existence," and which naturalists tell us, goes on continually in the universe of life. The varied tribes of living beings struggle for food, for room on the earth, and for other conditions of life. That such a warfare is proceeding around us, needs but common observation to prove. In this struggle, the weaker go to the wall, and the stronger survive and flourish. It has always seemed to me that this doctrine, applied first of all to explain the production of new species of animals and plants, has an equally important bearing upon human life and destiny. Everywhere in the human area there is competition for the necessaries of life—warfare and battling for the food without which we should hunger and die. But the knowledge that this struggle exists, carries with it the incentive to gird our loins for the fray. If the survivors in the battle for the conditions and means of life and living know their business, they will provide themselves with that knowledge which is better than riches, and which will thrice arm them to fight stoutly for existence. No unimportant part of such knowledge is that information which seeks to show how and why purity of air is the great condition for health of lungs and length of days—and conversely how and why impurity of air and errors in breathing, handicap us heavily in the struggle for life. It is no slight advantage to know, and to act upon the knowledge, that not merely does well-regulated breathing diminish mortality from consumption and from typhus and other fevers in healthy bodies, but that attention to the relation of lungs and air, ensures a longer life even to those who start existence with weakly bodies or enfeebled constitutions. The preservation of health and the prevention of disease are thus the two great results which flow from attention to my subject of to-night, just as they follow instruction in the other departments of physiology and chemistry in which you are to be instructed in the weeks to come. I need not, therefore, enlarge upon a subject which carries its application and moral written full in its face. The really happy home, at the formation of which reformers of this kind or that are ever aiming, must be a sanitary home—it must, above all, be a

well-ventilated home. You cannot preserve equanimity of mind in an atmosphere of carbonic acid; you cannot, I would say, "rejoice in the Lord" if you are respiring organic matter or other impurities, or if you are rebreathing your own breath or that of other people. The connection between a man's religion, his lungs, and the atmosphere, is not in any sense distant. If we have exploded the idea of the "sanctity of dirt," we may likewise extinguish the idea of the holiness and happiness of foul air. Those

"Sensations sweet,
Felt in the blood, and felt along the heart,"

that Wordsworth admires, are never present in the subject of impure blood and of vitiated air. The prevention of disease is likewise a part of my moral theme to-night.

"Who would not give a trifle to prevent,
What he would give a thousand worlds to cure?"

says the author of "Night Thoughts," and who, may I ask, knowing the conditions of disease that hourly encompass us, will not be up and doing in those matters which pertain to the health of the body, and to the prolonging of our lives. Surrounded by a fair and beautiful universe, breathing forth no curse upon man, but everywhere loading him with blessings and riches, the intelligent mind may well lift up its voice of thanksgiving for the nature and the beauty that gladdens heart and soul. But for none of the mercies of Nature should man feel more grateful than for the great air-ocean, and for its reviving pulsations and currents, which, freely bestowed as a condition of life, literally give to him the means of living and being. It is only when we think of all we owe to the atmosphere, and of our dependence upon it, that we can realise the importance of the topic upon which I have endeavoured cursorily to speak to you to-night. But once realising that importance, you may then appreciate at its true worth Paul's remarks, when, standing on Mars Hill and addressing the Athenian multitude, he counselled thankfulness to the Source whence came to them, as come to us, "life, and breath, and all things."

APPENDIX.

"LUNGS AND AIR."

1. The Lungs are Organs which act along with the Skin and Kidneys in getting rid of waste matters from the body.

2. These waste matters arise as the products of our bodily work—they are the ashes of the bodily fire.

3. The waste matters are—(1.) Water; (2.) a Gas called Carbonic Acid; (3.) Heat; (4.) Ammonia; (5.) Organic matters; (6.) Urca, &c.

4. The Lungs are always receiving *impure* (or *venous*) blood pumped into them by the heart. They are always sending back to the heart *pure* (or *arterial*) blood, fit for sending out from the heart to nourish the body.

5. The Lungs, therefore,—(1.) Receive waste matters *from* the impure blood; and (2.) Give *to* the blood, the *Oxygen* gas of the air we breathe in. This oxygen fits the blood anew for nourishing the body.

6. To keep the body in health we must therefore see that the air we breathe is pure. Every breath we give out contains *Carbonic-acid Gas*, which, if breathed long enough, and in sufficient

quantity, gives us first headaches, then causes drowsiness, and finally kills us.

7. We *ventilate* our houses to get rid of the Carbonic-acid Gas and other matters that come from our lungs. Every adult individual requires at least 1000 cubic feet of space to live in—a room 10 feet square and 10 feet high, represents the amount of space fitted for one person. Into this room there should pass 3000 cubic feet of air every hour.

8. Pure air is a mixture of two gases, Oxygen and Nitrogen.

There are of	Oxygen, ...	20·99 parts,	in 100 parts of pure air.
	Nitrogen,.........	78·97 „	
	Carbonic Acid,...	·04 „	
	Watery Vapour,	traces.	
	Ammonia,........		
	Ozone, ...		

9. In our rooms, and *especially in bed-rooms*, the fire-place should always be left unclosed, and the *flue or damper open for ventilation.* The windows should pull down from the top, and a piece of wire gauze should be fixed along the open space at the top; or a pane of glass should be perforated with holes capable of being closed in stormy weather. All rooms, and especially sleeping apartments, should be well aired during the day.

10. A good and simple test for impure air is to take a clear glass bottle with a glass stopper, holding about 10 ounces, and wipe it carefully inside and out. On entering a room, the air of which you wish to test, we should stuff a linen cloth into the bottle and rapidly withdraw it, so as to allow the air of the room to enter the bottle. Then carefully place a tablespoonful of clear lime water in the bottle, and replace the stopper. Shake it for a few minutes; then, if the air is pure, the lime water will remain clear. If bad, and loaded with carbonic acid, the lime water will become turbid, or even milky. This is because *lime* and *carbonic acid* together form *chalk*, which gives the milky appearance.

11. A fire in an open fire-place is a good ventilator in a way. We may ventilate a room easily by raising the lower window sash, and by placing inside the frame a piece of wood three or four inches high, and an inch in thickness, and reaching from one side of the frame to the other. When the inside sash is brought down to rest on this piece of wood, it is thus raised three or four inches. A current of fresh air moves inwards and upwards to the ceiling between the sashes, and if a piece of wood or glass, sloping upwards, be attached to the top of the lower sash, the current of air will be sent upwards to the ceiling, whence it will diffuse itself through the room. Draughts will thus be avoided.

12. Lastly, remember that lung disease is prevented by good ventilation, and that we should use cold water to the chest (except when in delicate health), every morning, and take free exercise when possible, avoiding chills, however, when warm.

THE BLOOD
AND ITS CIRCULATION.

BY DR FOULIS.

ON the evening of Saturday, 11th December, Dr Foulis delivered the fourth of the Course of Health Lectures in the United Presbyterian Synod Hall, his subject being, "the Blood and its Circulation, with Simple Practical Lessons." Dr Foulis said :—

LADIES AND GENTLEMEN,—THE BLOOD, as it flows in the living body, seems to be a thickish, heavy fluid, of a bright scarlet colour when it comes from an artery; but of a deep purple, or nearly black colour, when flowing from a vein.

Although to the naked eye the blood presents the appearance thus described, if we examine it under the microscope we shall find that it really consists of a colourless fluid, in which there are millions of minute coloured globules. These little globules are the real source of colour, which seems to the naked eye to belong to every part of the blood alike.

The colourless fluid portion of the blood is called the *liquor sanguinis*, or *plasma;* the coloured minute bodies are termed the *blood globules*, or *blood corpuscles.*

The blood of a man is heavier than water. Its S. G.* = 1055; that is to say, if a certain quantity of water weighs 1000 grains, the same quantity of blood will weigh 1055 grains.

Human blood has a peculiar smell, which is best perceived when blood is just drawn. It is not difficult to tell the kind of animal from which the blood is drawn by comparing the smell of the blood with the smell of the animal. The strong odour of the pig or cat, and the peculiar milky smell of the cow, are very easily detected.

In all mammals, *i.e.*, animals which suckle their young, in birds, reptiles, and fishes, the blood is of a red colour; but in those creatures which are termed invertebrates, that is, creatures which

* S. G. means Specific Gravity, *i.e.*, comparative weight.

have no back-bone, the blood is nearly colourless. There are, however, a few creatures belonging to the class of worms which possess coloured red blood—sometimes it is yellowish, bluish, or greenish in colour.

THE RED GLOBULES OF THE BLOOD IN MAN are so numerous that, in the thinnest layer under the microscope, they appear crowded together in such profusion as to cover each other or touch in every direction. They are so minute that 5000 of them might be placed on the head of an ordinary pin; and in such a drop of blood as would adhere to the point of a needle, there are about 3,000,000 of them; and if you took as much blood as would fill an ordinary walnut shell there would be packed away about eighty times as many of these little bodies as there are men, women, and children in the whole world. It is these little bodies that give the blood its red appearance.

Let us now describe these red blood globules more particularly.

We cannot see them with the naked eye. We must use a microscope to see them. Under the microscope they appear as circular or round bi-concave discs, with rounded edges. They are about $\frac{1}{3500}$th inch in diameter, and from $\frac{1}{10000}$ to $\frac{1}{12000}$th part of an inch in thickness; so that while about 3500 of these corpuscles lying flat on their sides in one continuous line would measure one inch, it would require about 12,000 of them if they were set up on their edges.

When viewed singly, they appear of a pale, yellowish, tinge, the deep red colour which they give to the blood being seen in them only when they are seen in a heap. They are composed of a tough, elastic, jelly-like material. The outer part of each corpuscle is denser or harder than the central part, and each little corpuscle is infiltrated or stained with a red colouring matter termed *hæmoglobin.*

If a minute drop of blood is placed upon a piece of glass, and then examined under the microscope, in a minute or so the corpuscles or globules of the blood arrange themselves in slightly curved rows or chains, in which they adhere to each other by their flat surfaces, presenting an appearance like that of a roll of coins. They arrange themselves in rouleaux. In a large jar of

blood, the globules after a time begin to stick to each other by their flat surfaces, forming the rouleaux, which in their turn begin to stick to each other, and thus little masses of rouleaux are formed, which gradually sink to the bottom of the jar, leaving the upper part of the blood clear and pale in colour. The corpuscles themselves are heavier than the fluid part of the blood—their S. G. = 1088.

In the blood vessels, the rapid movement of the blood keeps them diffused through the fluid. If water is added to some of these globules which are flat, they swell up, becoming quite globular or round like a ball. If the corpuscles are exposed to carbonic acid gas, they swell out, but if exposed to oxygen gas they become flattened.

Colouring Matter of the Blood.—The colouring matter of the blood is termed *hæmoglobin.* Its most remarkable character is its attraction for oxygen. In 100 lbs. weight of blood corpuscles there is nearly $\frac{1}{2}$ lb. of iron present.

In all vertebrate animals the blood contains red globules of which the colouring matter is the same as that in the blood of man.

In the dog, cat, rat, pig, horse, sheep, lion, monkey,—in pigeons, crows, frogs, fishes,—in the blood of all these and many other animals the blood globules are of a red colour, and the colouring matter is *hæmoglobin*, exactly the same as that in the red blood corpuscles of the human blood.

This hæmoglobin has been found to exist in the blood globules of every species of vertebrate animal. It has even been discovered in the blood of the horse-leech, and in that of the fresh-water shrimp.

Difference in form of the Blood Globules in different Animals.—Now, although in these cases the red globules contain the same colouring matter, they themselves are of different size and form in different animals.

Thus, in mammalians, or animals which give suck to their young ones, the red blood globules are of the same circular form and disc-like figure, except in those animals which belong to the

family of the camel, dromedary, and lama. In the camel and animals of that class, the red blood globules are oval-shaped, or elliptical.

The size of the red globules in mammals varies very much. Although they are all circular in their outline, they vary much in size.

The smallest red globules are those in the blood of the Java musk-deer, an animal not larger than a rabbit. The red globules in this animal are about the $\frac{1}{12325}$ part of an inch in diameter, *i.e.*, about a quarter the size of the red globules of a man's blood.

The largest red blood globule in a mammal's blood is that of the elephant—which is slightly larger than that of man.

A large animal does not necessarily possess large red blood globules; the red blood globules of a cat's blood are larger than those of the sheep, and those of a rabbit larger than either.

The largest red corpuscles known are those found in the blood of frogs and salamanders, in some of which animals they are ten times as large as those in man.

The blood globules of almost every animal have been carefully examined and measured, and we have tables of the sizes, so that the size of the red blood globules in most animals may be compared if necessary.

In birds, reptiles, and fishes, the red blood globules are distinguished by two very marked characters of shape and structure.

In these animals the red blood globules are oval in form, and have in their centres a little granular body, called a *nucleus.* The only known exception is in two species of fishes, belonging to the family of the lamprey, in which the globules have a circular form; but here also they are provided with a nucleus, and by this last character are readily distinguished from the circular, red non-nucleated globules of mammals.

An acquaintance with the form of the red blood corpuscles may prove of great importance in criminal cases. For instance, suppose a murder has been committed, stains resembling blood are observed on a knife belonging to the suspected murderer. He accounts for the stains by saying he has lately killed a hen or a duck. The truth of his statement may be readily tested. The suspected blood stain is moistened with a little white of egg, or

other liquid of the same density as the blood. To this liquid, the blood corpuscles, if present, will probably adhere, and the microscope would readily determine whether or not they belonged to the blood of such an animal as a hen. For remember the blood globules in a man are round, in the hen they are oval and nucleated.

A woman once came to an hospital, and stated that she had lately burst a blood-vessel, and was bleeding to death. With a view of shewing that she was telling the truth, she exhibited her handkerchief saturated with blood. The doctor, before he allowed her to go into the hospital, examined the blood under the microscope, and found the globules were oval and nucleated; that they were, in fact, the blood globules of a hen. When told that she was found out, she confessed that she had killed a hen and had soaked her handkerchief in the blood.

Now, for what purpose have we blood globules in the blood? There can be no doubt that the red blood globules serve mainly as carriers of oxygen to all parts of the body. As a general rule, those animals which have few but large blood globules—such as frogs and salamanders, are lazy luggish animals; but in those animals where the red blood globules are small but very numerous, the respiration, the circulation of the blood, and all the functions of the body are increased in activity.

These little red blood globules have each a duty to perform. After their work is done they perish. We cannot move a finger or a limb; we cannot speak, or think, or laugh, without thousands of these little red globules perishing. It is calculated that every second as many as 20,000,000 of these little red blood globules perish in our bodies.

White Blood Globules.—Now mixed up with the red blood globules, we find another little body in the blood called the *white blood globule.* It is called the white blood globule because it has no colour. In this respect it is altogether different from the red blood globules. In health, there may be 1 white blood globule to every 400 or 500 red blood globules in the human blood, but in some diseases, the proportion may mount up as high as 1 to 10. In their general appearance. these white globules are round like a ball,

being the $\frac{1}{2500}$th of an inch in diameter. They contain within them two or three solid-like, but very small bodies, called nuclei. It is supposed that these white globules are the parents of the red blood globules, and their little nuclei really become red blood globules.

Coagulation of the Blood.—I will now speak to you about the clotting or coagulation of the blood. I have in this jar some ox's blood. You will see that it is made up of two parts, a solid jelly-like mass, and a watery-looking fluid. Let me explain this: If you allow blood to flow from the veins of an animal, or from one of your own veins, into a basin, and leave it to stand a short time in a room, you will find that it will separate into two parts,—one part, a sticky jelly-like mass, settles down to the bottom: and the other part, a straw-coloured fluid, called the *serum*, occupies the rest of the vessel.

The jelly-like mass is termed the "clot." The clot you see is a bright scarlet colour. What gives it this colour? It is due to the countless number of little red blood globules which are now heaped or collected together in a mass. Now the clot is not formed of these little red globules alone. In the clot there is a substance called *fibrin*. The clot really consists of an extraordinary network of fibrin, in the meshes of which are contained immense numbers of the little red blood globules.

Now I want to explain to you that this fibrin does not exist as *fibrin* in the freshly-drawn liquid blood. It begins to be formed in one or two minutes after the blood escapes from a vein or blood-vessel of a living animal. I told you that the blood itself consists of the red and white blood globules which float in a clear liquid called the liquor sanguinis or plasma. If blood is allowed to run out of a vein into a tall vessel such as this jar, the red and white globules begin to fall down towards the bottom of the jar, and would do so in course of time, just as a lot of red currants, if thrown into a jar of clean water would fall to the bottom. But, in healthy blood, in a minute or two after it is poured into a jar, the clot begins to be formed, and it forms throughout the entire mass of the blood in the form of a net-work of fibrin, consisting of an immense number of little meshes; and, as this clot is being formed

the countless numbers of little groups of red blood globules are caught in the newly-formed meshes, and thus the red blood globules are prevented from falling to the bottom of the jar, and the clot itself appears as a bright scarlet mass of jelly-like substance, floating in the fluid part of the blood. It is this formation of fibrin in freshly drawn blood that brings about that change which is called the coagulation of the blood. The clot then consists of fibrin and blood corpuscles.

After the clot is formed, it becomes gradually smaller, because the fibrin in it has a tendency to contract; and as it contracts it squeezes out a clear yellowish liquid which you see occupies the jar, while the clot floats in it. This liquid which remains is now called the *serum.*

As I said before, the corpuscles of the blood are slightly heavier than the liquor sanguinis, and they sink, though slowly, to the bottom. Hence the upper part of the clot contains fewer corpuscles, and is lighter in colour than the lower part, there being fewer corpuscles left in the upper layer of the plasma for the fibrin to catch when it sets. There are some conditions of the blood in which the corpuscles run together more rapidly, and form little groups more dense than usual. These denser or heavier groups of blood corpuscles, of course, fall more rapidly to the bottom, just as a bundle of feathers falls more rapidly to the ground than a handful scattered in the air. When this is the case, the upper part of the liquor sanguinis is quite free from blood corpuscles before the fibrin forms in it. Consequently the uppermost layer of the clot is nearly white. This white part of the clot has been termed the *buffy coat.* You will easily see from what I have said that the part of the clot called the buffy coat is fibrin naturally separated from the red corpuscles.

In this vessel I have some clean white fibrin which corresponds to that fibrin which is called the buffy coat. This clean white fibrin is the clot, without any red corpuscles in it, and it is got in the following way:—

Bullock's blood, or the blood of any animal, is allowed to flow into a jar. With a bundle of twigs the blood is constantly stirred or whipped as you whip up an egg. The result of this is that the

fibrin is collected on the twigs, and a red fluid is left behind which consists of red blood corpuscles floating in the serum of the blood.

Now, if this fibrin which is caught on the twigs during the whipping of the blood is washed in fresh water frequently, any red blood corpuscles that may be sticking to it become washed away, and the fibrin appears as a white stringy substance, such as I now show you.

Now this coagulation or clotting of the blood always takes place when blood escapes out of a vein or blood-vessel. The blood never clots within perfectly healthy living blood-vessels, such as veins and arteries. You will ask me what makes the blood clot, and where does the fibrin come from if it does not exist as such either in the blood globules or in the liquid part of the blood?

Let me try to answer the first question, What makes the blood clot?

I think I can best answer this question by telling you that blood in the healthy veins and arteries of a man or any animal does not clot; but directly it escapes from a vein or an artery and comes in contact with any dead material, such as the ground, or a stone, or a glass jar, or any kind of vessel, it at once begins to clot or coagulate. Or, in other words, the mere contact of dead material with blood causes the formation of fibrin in that blood. The blood then coagulates whenever it comes in contact or touches lifeless or dead material.

As the blood flows along in the living blood-vessels it remains fluid, just as we see it, immediately it escapes from a blood-vessel. If, however, a needle or a piece of wood is thrust into a living blood-vessel, the blood which comes in contact with that needle or piece of wood clots or coagulates But I have something more to tell you as to what causes the coagulation of the blood.

It is a very wonderful thing, and you all have noticed it, that if you cut your finger or prick yourself, although at first a little blood escapes from the wound, yet after a little time the bleeding ceases. Why is this? why does the wound not go on bleeding till you have lost every drop of blood in your body? Well, the blood ceases to flow from the wound, because very soon after the blood comes in contact with the cut or wounded flesh it begins to coagulate or clot, and the clot forms a plug or cork to the open

ends of the little injured blood-vessels. It is the formation of fibrin or clot in the wound, and in the mouths of cut blood-vessels, that prevents us bleeding to death whenever we cut our flesh.

Sometimes, however, the blood-vessels which are cut are so large that the clot has not time to form a sufficiently firm plug to the bleeding vessels, before it is driven out by the stream of blood —for, remember, the blood does not coagulate at once directly it escapes from a blood-vessel, but it takes a minute or two to do so. When the clot is thus driven out of the wound there is danger of bleeding to death, unless proper means be taken to stop the escape of blood.

We learn, then, that the blood does not coagulate in the healthy living veins and arteries, but it begins to clot directly it comes in contact with ordinary dead matter, such as jars, cups, stones, &c., and it begins to clot directly it comes in contact with cut or wounded flesh. The fibrin, which, as I have explained to you, is the chief part of the clot, has been called Nature's Glue. Now, let me try to answer the second question, If fibrin does not exist in the healthy liquid blood as fibrin, where does it come from?

No one as yet has been able to say for certain how the fibrin is manufactured in the act of coagulation of the blood; but it is supposed that in the healthy blood, or rather in the liquid part of it, there exists a substance called *fibrinogen*, and there is another substance called *globulin*, which is supposed to be in the red blood globules. Before coagulation takes place these substances exist separately, but when coagulation takes place, the fibrinogen seizes the globulin, and by their union or combination fibrin becomes formed. And, as I have already explained to you, it is the contact of blood with cut flesh or with ordinary dead matter, which causes these two substances called fibrinogen and globulin to combine to form fibrin.

This is all the explanation I can give you as to the formation of fibrin, or nature's glue.

There is nothing more interesting than the fact, that as long as blood is in the healthy living blood-vessel, it shows no tendency to coagulate. It is supposed that the inner surface of all the blood-vessels exerts some kind of influence on the blood, and prevents it coagulating; for whenever the inner surface of a vein

becomes inflamed or injured, the blood shows a tendency to clot in connection with that part. It is only the other day I heard of a lady who suffered from inflammation of the veins of one of her legs—a clot of blood formed at the part inflamed; and this becoming detached was carried by the circulation of the blood into the heart, and caused her death.

So much, then, for the coagulation of the blood.

You will observe that, besides the clot in this vessel, there is a straw-coloured liquid. This liquid is, as I said, the *serum* of the blood, or that part of the liquor sanguinis which remains after the formation of the fibrin. In this serum are dissolved a number of substances. I will boil a little of it in this flask. You see that it turns white and thick. This is owing to the presence of albumen in it—the same substance that you know as the white of an egg. Here is some white of egg dissolved in water. If I boil it, you see it becomes like the serum when boiled. It is the nature of albumen, or white of egg, to become white and solid when heated to a temperature of 170° Fahr. Now, as the serum also contains albumen, it is natural that it should undergo the same changes here that it does in the egg. Serum contains a very large quantity of albumen; it must serve some useful purpose, or it would not be there.

Serum of human blood is composed of a mixture of various substances, dissolved in about nine times their weight of water. Now, albumen is one of the chief of these substances dissolved in the serum. There are about 70 parts of albumen in every 1000 parts of blood.

Besides the albumen, we have dissolved in the serum substances called fatty and saline matters, such as potash, soda, lime, &c. The fat is stored in the serum in the form of a soapy material. You know that when oil is mixed with soda or potash, a sort of soapy material results. The presence of a lot of soda and potash and other alkaline substances in the serum is the means by which the fat is dissolved in the blood. These fatty materials are the means by which the fat of the body is built up, and they form a large part of the milk upon which the young of all animals feed. They also, by combining with oxygen in the blood, help to keep up the heat of the body.

The most important constituents of the blood are its saline substances. Our flesh and bones contain a large quantity of minerals or salts. Suppose we were to pound up a man of ordinary size in a mortar, and then analyse the constituents of which he is composed, what should we find? Why, we should discover that at least ten parts out of a hundred consist of mineral matters. We should get lime, and iron, and sulphur, and phosphorus, and many others. Now, if these substances are present in the tissues, they must be also present in the blood, because the tissues all feed on the blood, and draw their supplies from it.

But you will ask me, How do these mineral substances get into the blood? How does a hard substance like lime, for instance, find its way into the blood, and how does it reappear in the form of bones and teeth? Though lime gets into the blood, still it does not enter it as a solid; it becomes dissolved in the blood. Our digestive systems have the power of digesting food, which contains lime in various forms; and it is by our digestive systems that we take into the blood the many mineral substances found in it. See, here is a glass which appears to contain water only, but in reality it contains an egg-shell dissolved in it; the egg-shell consists of lime. By adding a few drops of muriatic acid to the water, and then placing the egg-shell in it, the latter becomes dissolved. If some of this liquid was mixed with our porridge, it would pass during digestion into the blood, and then the lime in a dissolved state would be carried by the blood into all parts of the body. When lime is required in the form of a bone or a tooth, the blood lays it down in the exact spot where it is wanted. All our bones and teeth have been formed in this way from the blood. The blood contains lime in solution, and carries it to the parts of the body which require lime. Now, it is most important that you should know that the lime of which our bones and teeth are formed can only get into the blood from the food we eat. If that food does not contain sufficient lime, then the bones and teeth are not properly formed, and they may suffer from disease. If children do not get sufficient lime in their food their bones do not become hard and firm, but remain soft, and often become bent and distorted. I am sorry to say that during the last few months I have seen a number of young children in the streets

whose legs were much bent and deformed. Some of the poor little creatures I have seen had their legs almost bent in the form of a bow. Now, why is this? It is because the food of these children has not contained sufficient lime for the blood to carry to the young growing bones, and thus the bones have remained soft and yielding, and they are unable to bear the weight of the body, and thus become bent and twisted.

This is what happens in the disease called Rickets. Who is to blame for this? Why, the parents of these children. Had these children been fed upon plenty of good milk during the first year or two of their lives, they would not be now suffering from deformities.

Nature intended all infants, and even the young of all animals, to be fed upon milk. Milk would have supplied them with lime in abundance, but the parents have fed them rather upon such foods as sago, arrowroot, tapioca, cornflour, from which the young child cannot absorb enough lime for the growing bones. Consider how the big bones of a calf or a young foal grow strong. Their bones at first are soft, like gristle: but as they grow they become hard and firm, because a great amount of lime enters into their structure. These young animals get nothing but milk to feed upon for a long time, but it is quite sufficient to supply their growing bones with all the lime that is required to make them strong.

Now, when poor little children do not get enough milk and those foods which contain lime, such as porridge, their bones remain soft, and the parents may have the distress for ever of seeing their children grow up as cripples, with crooked arms and legs, instead of being fine, strong creatures, as nature intended them to be.

See, here is a piece of bone which I have placed in weak muriatic acid. By this means the bone has been robbed of its lime. You will see that I can cut it easily with a pen-knife, and I can bend it or twist it as if it were made only of gristle. This softening of the bone takes place because it has been deprived of the lime it naturally contains. In the same way the bones remain soft and yielding in young children if they do not get a proper supply of lime in their food.

Remember then that milk, and milk alone, should be the food of infants up to the age of nine months, and after that they should still get milk mixed with their other foods for several years.

I told you that, besides lime, the blood contains many other mineral substances. All these are dissolved in the blood. If you place some salt or sugar in water, you know it becomes dissolved, and disappears from sight; but it is there, because you can taste it. In the same way, all the mineral substances find their way into the blood. They first exist in the food which we eat, and, during the process of digestion, they become dissolved in the blood, and the latter carries them to all parts of the body. I said that iron is found in considerable quantity in the red blood globules, and, indeed, is the cause of the red colour of these little bodies. We medical men are often consulted by patients who seem to have lost their strength—they are pale, and, as we express it, bloodless. The cheeks and lips, instead of being ruddy in colour, are pale and colourless. In such cases we give iron as a medicine, because we believe that the blood globules are deficient in iron in such cases, and often we are rewarded by finding that our patients soon regain their healthy condition and colour. In the same way, when we think it necessary, we give as medicines sulphur, phosphorus, magnesia, soda, and potash.

Mineral Substances, such as are found in the blood of every human being, are as necessary for health as the meat, and bread, and potatoes that you eat. If you exclude all mineral substances from diet or food, you will as certainly die as if you were deprived of all flesh-forming food.

Gases of the Blood.—Now, not only does the blood contain mineral substances in it, but it also contains gases dissolved in it. If you take up a bottle of soda water or potash water, it appears to consist of a clear liquid; but pull out the cork, and what do you observe?—why, it fizzes. This fizzing is caused by the escape of carbonic acid gas which was dissolved in the water. After a time the fizzing ceases, because a large quantity of the gas has escaped, but there is still some gas dissolved in the fluid.

In the same way as you have gas dissolved in the soda water,

so you have gases dissolved in the fluid of the blood. The gases dissolved in the blood are oxygen, carbonic acid, and nitrogen, the very same as exist in the air we breathe.

In 100 volumes of blood, say quarts, you have about 50 or 60 volumes of these gases altogether; or, in other words, in a quart of blood you have about a pint of these gases altogether, about $\frac{2}{3}$ pint of carbonic acid, $\frac{1}{3}$ pint of oxygen, and about $\frac{1}{10}$ pint of nitrogen are dissolved in one quart of blood. It appears that the oxygen gas is held in combination with, or clings to, the hæmoglobin, which I told you was the colouring matter of the red blood corpuscles. So much, then, for the minerals and gases contained in the blood.

Allow me now to say a few words about the quantity of blood contained in the body of an ordinary-sized man. It is extremely difficult to find out the exact quantity of blood in the human body. In some foreign countries they do not hang the criminals; they decapitate them, or cut off their heads. Now, it occurred to some scientific men that the best way to tell how much blood is in the body would be to weigh a criminal just before his head was cut off, and then to weigh the head and trunk after the blood had drained out of them. The difference in weight would then be the weight of the blood in the body before the head was cut off. Now, as the result of many observations of this kind, it has been found that the blood in the body is about 12.5 per cent. of the entire weight of the body; that is to say, if a body weighs 100 lbs., it contains about 12 lbs. of blood.

I have now spoken to you about the red and white blood globules of the blood, the coagulation,—and the mineral and gaseous constituents of the blood,—let me now proceed to describe to you the way in which this wonderful fluid, the blood, is carried about and distributed to all parts of the body.

If it is true that the tissues and various organs of the body are in constant need of blood, there must be some special apparatus whereby this blood is distributed to them. In the upper part of the body here, in the chest, you have a powerful forcing-pump, called the *heart*, from which pipes are distributed to all parts of the body, and there is another set of pipes which carry back the blood from all parts of the body to the heart again. The pipes

which carry the blood from the heart are termed the *arteries*, and the pipes which carry it back to the heart are called *veins*.

You see here (pointing to a large diagram) the pipes which carry the blood away from the heart. They are called arteries because they were supposed, a very long time ago, to contain nothing but air. Here you see the great artery of the body passing directly from the upper part of the heart, and bending backwards till it comes in contact with the spine. It passes down along the backbone, and then divides into two trunks, which pass down the legs.

Let me now say a few words to you about the structure of these arteries.

Each artery has three coats. They are not made throughout of some one substance, as a gas pipe is, but they are made up of different materials woven together.

One of these coats, the external one, is very elastic; another, the middle one, is contractile. Now we called a substance *elastic*, when it returns to its original size with a sort of spring, after it has been stretched or drawn out. Here is the aorta, a large blood-vessel, which lies against the backbone of an ox; when I pull it out it stretches and returns to its original size at once. India-rubber is elastic; we say a substance is contractile when it squeezes or contracts on itself or its contents. Now, an elastic and a contractile coat are found in every artery. The elastic one is the external one; the contractile one is the middle coat, and it always consists of a peculiar kind of muscle. The thin or internal coat of an artery is also an elastic coat, and it lies within the muscular or middle coat. Its inner surface is lined with a layer of beautiful but very small plates called endothelial cells, which allow the blood to flow over them as smoothly as if they were polished tiles.

You will naturally ask me how do the arteries end? what becomes of them? It is only by the aid of the microscope that we can answer this question.

The main arterial tubes or pipes which carry blood from the heart, divide and continue to give off branches, or smaller pipes, until they become so small that we can hardly see them. All parts of the body except the cuticle of the skin, the hair, the teeth, and the cartilages which cover the ends of bone, are pierced

through and through by small arteries which are characterised by possessing the three coats which I described to you. Now, these minute arteries terminate in still smaller pipes or tubes called *capillaries.* These capillaries or hair-like tubes are so numerous that it is impossible to prick oneself with a needle without rupturing some of them.

These minute tubes ramify or branch in every direction through the different parts of the body. They vary much in size, some of them are not more than the 5000th part of an inch in diameter; the most common size being about $\frac{1}{3000}$th of an inch. You can sometimes see the minute tubes in the white of the eye when it is bloodshot. In this state of the white of the eye, the little capillaries are gorged or crammed with the red globules of the blood. Please remember that the large arteries continue to divide until the branches or offshoots become extremely small, and the smallest ones become continuous with, or join the minutest tubes, called the capillaries. Now, how do we distinguish between a minute artery and a minute capillary? The microscope again comes to our aid. Any artery has three coats, but a capillary has only one coat, which consists of a very delicate transparent membrane, with little dots or nuclei in it.

But you will ask, Where do the capillaries end? They in their turn end in very small tubes called veins. The arteries, becoming smaller and smaller, end in the capillaries, and the capillaries becoming gradually larger end in the smallest veins, which in their turn gradually become larger and larger until they join the main large trunks or pipes which carry the blood back to the heart.

You see that the arteries carry the blood away from the heart to the capillaries. After the blood has passed through the capillaries, it passes into the veins, and returns to the heart.

The veins are tough-walled tubes or pipes, and they are remarkable, inasmuch as they possess valves, or cup-like folds of their lining membranes, so arranged that, while they allow the blood to flow towards the heart from the capillaries, they won't allow the blood to flow back from the heart to the capillaries. The blood can only go in one direction in the veins, *i.e.*, towards the heart.

So much, then, for the tubes through which the blood flows during its circulation.

I will now describe shortly the forcing pump—the heart—which forces the blood through the arteries, capillaries, veins, through the lungs, and back to itself again. Where is the heart situated? It is situated in the chest, behind the breast-bone, but more to the left than the right side. The lower portion of the heart—the thinner end of it, called the apex—inclines towards the left side, where it may be felt to beat between the fifth and sixth ribs, about two inches to the left of the breast-bone.

You may get a very good idea of the size of the heart by looking at your doubled-up fist. The heart lies in a bag called the *pericardium*, almost surrounded by the lungs, which, along with some other structures, occupy the whole cavity of the chest. Here is the heart and lungs of a sheep. When blown up you will see the lungs almost surround the heart.

The heart may be described as a hollow muscular ball, divided into four cavities, by a vertical septum or partition, and by a horizontal septum or partition. The two upper cavities are called the *auricles;* the two lower are called the *ventricles* of the heart. Each of the four cavities is capable of containing from four to six ounces of blood. The walls of the auricles are much thinner than those of the ventricles. The wall of the left ventricle is much thicker than that of the right ventricle. The left ventricle is the most powerful, because it has most work to do. The wall of the left ventricle is nearly a half inch in thickness.

There are thus four cavities altogether in the heart—two auricles and two ventricles. Remember that the auricle and ventricle on the right side are quite separate from the auricle and ventricle on the left side. The right auricle communicates with the right ventricle, and the left auricle with the left ventricle, through holes about an inch in diameter, which are in the partition between the auricles and ventricles. These are called the *auriculo-ventricular* openings.

In speaking of the arteries, I pointed to the main trunk called the aorta. This large trunk is directly connected with the top part of the left ventricle. If you could pass your finger into the cavity of the left ventricle, you would be able to pass it onwards into the opening of the great arterial pipe—the aorta. Following this artery in its course, it gives off branches in every direction,

which ultimately end in the millions of capillaries which I told you pierced the tissues in all parts of the body. All the minute veins into which the capillaries pour the blood, gradually end in two large venous trunks—one coming from the head and upper limbs, the other coming from the lower limbs and the rest of the body. These two large venous pipes become connected with the right auricle by an opening which you could put your two fingers into.

Now, there is connected with the top of *the right ventricle* another tube called the *pulmonary* artery, because it goes direct to the lungs. It is also a large tube, and you could easily put your finger through the opening with which it communicates with the right ventricle. And, lastly, looking at the left auricle, we find there are two or more large veins which pass into it. On tracing these veins, we find they come from the lungs; in fact, they are the tubes which convey the blood to the left side of the heart direct from the lungs.

The Circulation of the Blood.—Now let me describe to you the circulation of the blood.

I will begin with the left ventricle. Let us suppose the left ventricle is full of blood. The blood which is now about to be pumped out of the left ventricle into the great artery, the aorta, is scarlet in colour, and in a purified state. The left ventricle gives a sudden contraction, or it squeezes upon its contents. The result is that nearly six ounces of blood are forced into the large artery connected with it. Some of you may ask, Why, if there is an opening between the left auricle and left ventricle, why does not the blood pass into the left auricle, as well as into the aorta? When the left ventricle contracts, the blood cannot get back into the left auricle, because there are two large valves so placed at the left auriculo-ventricular opening that they come together like the flood gates, which you have often seen in the canal. These valves are tough membranous flaps, and they hang downward into the cavity of the left ventricle, and are fastened by their free edges to the inner surface of the ventricle by peculiar strings called chordæ tendineæ. Now you see, when the left ventricle is full of blood, and it contracts, some of the blood gets up behind these valves and

they flap together, closing the auriculo-ventricular orifice. These valves would be forced backwards into the auricle, if they were not tied, as it were, to the wall of the ventricle by the little strings. Well, as the blood cannot get back into the left auricle, it is forced on into the great artery. Now I told you that the arteries were all elastic. When the blood is forced into the artery, the artery becomes distended, and being elastic it rebounds, and recoiling squeezes on its contents with the same amount of force with which it was distended.

By its recoil it has a tendency to drive some of the blood back into the left ventricle. Now this would certainly happen if there were not, at the orifice of the artery, three little cupped-shaped valves, so arranged that, while they do not hinder the passage of blood from the ventricle into the artery, directly the elastic artery rebounds and presses the blood backward into the ventricle, these little cup-shaped valves come together at their free margins, and at once stop the backward flow of blood from the aorta into the ventricle. The blood then not being able to get back is forced on through the arteries into the capillaries. It passes through the capillaries into the veins,—the veins from the upper half and from the lower half of the body end in two large venous trunks, —and by these the blood, which is now black or purple in colour, passes into the right auricle. The right auricle contracts, and the blood is driven through the right auriculo-ventricular opening into the right ventricle. The right ventricle in its turn contracts, and the blood is driven into the pulmonary artery on to the lungs.

The blood cannot get back from the right ventricle into the right auricle, because there are three valves at that opening exactly like the valves which I described at the left auriculo-ventricular opening. When the right ventricle contracts, the dark blood gets up behind these valves which flap together, and prevents the backward flow into the right auricle. It is therefore forced into the pulmonary artery. The pulmonary artery is very elastic and rebounds upon the blood within it. The blood would be forced back into the right ventricle by the rebounding artery if it were not for three little cup-shaped valves situated just within the orifice of the pulmonary artery, and so arranged that

they do not hinder the passage of blood onwards towards the lungs, but they will not permit the blood to flow back into the right ventricle. The impure black blood is thus forced on into the lungs, where it passes into the capillaries, which are so numerous that if they were united they would extend for miles and miles.

The capillaries lie in the walls of the air cells of the lungs. It is said that if these air cells were spread out they would cover a surface 300 yards long by one yard wide. In the lungs the blood is spread out over this surface in the act of being purified.

It gives out carbonic acid and water and animal matters, and takes in or absorbs oxygen gas, which goes to the red blood globules. The blood is by this means changed from a black or purple colour to a bright scarlet. It then passes from the capillaries of the lungs into minute veins, which gradually become larger till they end in those three or four trunks which pass into the left auricle. The left auricle becomes thus filled with bright scarlet blood, and it gives a contraction. The pure bright scarlet blood is thus forced on to the left ventricle to be once more sent into the aorta, as I have already described, and distributed throughout the body. There are thus two circulations—the systemic and pulmonary circulation.

In the systemic circulation, rich scarlet blood is sent to all parts of the body to nourish all the tissues and organs of the body. But in the pulmonary circulation, the impure or venous blood is sent to the lungs to be purified. It then gives out carbonic acid gas, water, and animal matters, and absorbs a large quantity of oxygen gas. It becomes a bright scarlet colour, and then passes into the left auricle on its way to begin the systemic circulation. Now, you may ask me, Why is it that the blood is at one time black and at another time red? This change in colour depends upon the quantity of oxygen there is in the blood. If blood contains much carbonic acid and little oxygen, it is black or purple coloured. If it contains much oxygen and little carbonic acid, it becomes bright scarlet. In the arteries the blood is always scarlet. In the veins it is always blue. It is supposed that arterial blood is red, because the oxygen in it makes the blood globules flat or bi-concave, and these readily reflect light that falls upon them, and thus

appear red; but carbonic acid gas causes the red blood globules to swell out and become round, and thus they do not reflect light, but in a mass appear dark purple or blue-coloured.

Sounds of the Heart.—If you place your ear over the heart of a man and listen attentively, you will first of all feel the beat or the impulse of the heart. The top or the apex of the heart strikes the wall of the chest between the fifth and sixth ribs whenever the ventricles contract, and at the same time you will hear two very peculiar sounds, which are called the heart's sounds. These sounds follow each other quickly, and may be closely imitated by the words *lubb—dupp*. These two sounds are succeeded by a pause, and then we hear them again. You hear the first sound when the ventricles contract. It is supposed to be produced by flapping together of the valves at the right and left auriculo-ventricular orifices; and the second, or "dupp" sound, is supposed to be produced by the flapping together of the valves at the orifice of the aorta and pulmonary artery.

The auricles and ventricles work in pairs. The two auricles contract, and then the two ventricles contract. Whenever the ventricles contract, a large quantity of blue blood is sent into the pulmonary artery, and a large quantity of red blood is sent into the aortic artery.

If a finger is placed on an artery at the wrist, what is termed the pulse will be felt—that is to say, we feel under our finger the wave of blood that is produced by the injection of blood into the already full aorta. The wave of blood as it travels onwards, expanding or dilating the vessel, produces the pulse in it. The pulse at the wrist is felt immediately after the contraction of the left ventricle. You may feel a pulse at your ankle in the artery there, but it will be felt a second or so later than the pulse at the wrist, because the distance the wave of blood has to travel is greater. When an artery is cut across, the red blood which it contains escapes in jerks. The explanation of this is, that when the heart pumps blood into a cut artery, the force which should be employed in distending the elastic walls of the artery is spent in jerking the fluid out at the cut end.

The pulse cannot be felt in either veins or capillaries. When

capillaries are cut across, the stream of blood that escapes is quite steady—the blood oozes out, as we express it. This is explained by the fact that the capacity of the branches of an artery is greater than the capacity of its trunk, and the capacity of the capillaries as a whole is greater than that of all the small arteries put together. Hence the pulsation in the capillaries is so diminished in intensity that it cannot be felt. You will have learnt from all that I have now said that the contractions of the heart and the elastic recoil of the arteries are the two great forces of the circulation.

The heart in a healthy adult man contracts from 70 to 75 times in a minute. The force with which the left ventricle contracts is said to be equal to about the $\frac{1}{50}$th of the weight of the whole body; that of the right ventricle being equal to only $\frac{1}{100}$th of the same. Each ventricle is able to contain from four to six ounces of blood, the whole of which is driven into their repective arteries at each contraction. It has been calculated that the heart in twenty-four hours does work equal to about 124 foot tons—that is, the work done by the heart in twenty-four hours is equal to the amount of force necessary to raise 124 tons one foot high.

There is one more very important subject I must speak to you about in connection with the arteries, and that is the influence of the nervous system on the circulation of the blood. You must all have experienced that palpitation or jumping of the heart when you have been suddenly startled or frightened. The whole of the blood vessels and the heart are connected by nerves to the brain and spinal marrow. The small arteries throughout the whole body, as I have already pointed out, possess a muscular coat, which, by contracting, is able to diminish the capacity of the arterial tube. Now, connected with the muscular coat of each artery are numerous nerves, whose duty it is to regulate the calibre of these vessels; the result being that the nervous system is able to control the circulation of the blood in various parts.

Let me give you an example. Take the act of *blushing;* it is a purely local affection. How is it caused? An emotion sometimes pleasurable, sometimes painful, takes possession of the mind. Thereupon a hot flush is felt; the skin of the face grows red. The face grows hot and red because the blood-vessels contain an increased quantity of the red and hot fluid. Its vessels contain

this increased quantity of blood because the small arteries suddenly dilate; the contractile power of the arteries being lost for a time, owing to the nerves which control the contraction being affected by a mental emotion.

During its circulation through the body, the blood is being continually deprived of some of its constituents. The numberless organs and tissues of which man's body consists are undergoing perpetual change, and in carrying out its function, some part of each organ is destroyed. Thus we cannot think, feel, or move without wasting some portion of the brain, nerves, or muscles.

The wasted or used-up material cannot remain in its original situation, where it would be not only useless but injurious. Such old material is being daily removed from our bodies to the average amount of three or four pounds. Now, to take the place of that old material daily removed, there should be daily added at least an equal quantity of fresh material. It is by the aid of digestion of food that we are able to add to the blood such new material as will take the place of that used up in the functional activity of the various organs of the body.

When we eat mutton chops, beef, bread, and potatoes, you know as well as I do that these substances do not pass directly into the blood. They must be prepared—they must be acted upon by the teeth, mouth, stomach, and bowels, and the various secretions of the alimentary canal before they can pass into the blood. Let me then give you a short sketch of the process of digestion by which the food is prepared for absorption into the blood, and for the nourishment of the various tissues.

When food is taken into the mouth, it is divided and crushed by the teeth, and at the same time it is mixed with the saliva. This fluid has the property of converting starch—such as is so largely found in arrowroot, rice, or potatoes—into grape sugar. The glands which pour out saliva are situated in the mouth; they give out nearly two and a-half pints of saliva in twenty-four hours. People who bolt their food often suffer from indigestion. Food should be chewed slowly, so as to allow the saliva to mix well with it. After being chewed and well mixed and moistened by the saliva, the food passes down into the stomach. In the stomach the albumen matter, such as meat contains, is dissolved, and part

of it becomes absorbed at once. The whole contents of the stomach are passed on into the intestine. The upper part of the intestine is called the *duodennum;* as the food passes through this it gets mixed with the *Bile* and the fluid of the *pancreas.* By this means the fatty parts of the food are rendered soluble, and as they pass along the intestine they become absorbed into the blood. The mucous membrane of the intestines is arranged in the form of folds, which delay the passage of the food, and at the same time allow little vessels called *lacteals* to suck up the fluid part of the digested food called the *chyle,* which is then passed on into the blood, and conveyed in the circulation to the different parts of the body.

By means of food properly digested we maintain the healthy condition of the blood. The oxygenised bright scarlet blood travels very rapidly through the large arteries; but when it reaches the capillaries, the current becomes very slow—the blood is spread out, as it were, the object being that all the tissues may come into intimate relation with the blood. The capillaries possess exceedingly thin walls, and during its circulation through them, some of the fluid parts of the blood, by a process of exudation, pass to the tissues in which the capillaries lie, and irrigate or bathe them. But just as new material passes out of the blood, so used-up material passes into the blood in the capillaries, and now the blood begins to get black or purple coloured. Loaded with waste products it returns to the veins, and then into the right side of the heart, to be pumped to the lungs for purification, during the process of which the waste products are given off or discharged by the breath in the form of carbonic acid, water, and animal matters.

But, besides the lungs, there are other means of getting rid of the impurities of the blood. Thus the skin and kidneys eliminate a great amount of waste products. Thus the lungs give off much carbonic acid, much water, and a little urea or ammonia. The skin throws off much water and animal matters; while the kidneys throw off much water and much urea, which is a nitrogenous substance.

Oxygen is well described as the great sweeper of the body. In its passage through the capillaries it seizes upon all the used-up particles, combining with them, converting them into carbonic acid, water, urea, etc.

Now, it is by this process of oxidation, or burning off of the tissues, that the heat of the blood is kept up ; and by the help of the lungs and skin the temperature is kept steady and uniform.

Every minute the heart beats seventy-five times. This goes on day after day and year after year. The blood rushes and whirls along, feeding the different organs and tissues of the body, taking up all the impurities, and carrying them to the lungs, skin, and kidneys, to be thrown off as useless and poisonous materials.

I have spoken to you several times about oxidation. Let me show you an experiment to explain what is meant by oxidation. Whenever oxygen combines rapidly with a substance, such as charcoal or carbon, it gives out much heat and light, and carbonic acid is the result of the chemical combination. (Dr Foulis burnt a piece of charcoal in pure oxygen gas.)

If carbonic acid, which is one of the impurities of venous blood, were not thrown off by the lungs and skin, the individual would certainly die in a short time. Carbonic acid, unlike oxygen, will not support life. The air we breathe contains 79 parts of nitrogen and 21 of oxygen in 100 parts; the nitrogen is mixed with the oxygen to dilute it. We cannot for long breathe pure oxygen ; it would burn us off too fast. When a number of human beings or other animals are collected together in a small room, the air of the room soon becomes poisonous unless the ventilation is good, because the carbonic acid and other impurities that are thrown off from the lungs and skins of the individuals accumulate to such an extent that the rest of the good air becomes so vitiated that it is injurious to breathe it.

To keep the blood pure one must have a certain quantity of fresh air to live in. At the least a man should not live in a room which contains less than 800 cubic feet of fresh air. Oxygen is the great supporter of life and health—carbonic acid will not support life.

Let me show you the effect of carbonic acid on a burning candle. (Dr Foulis then poured carbonic acid gas on a lighted taper in a jar ; the taper went out.) By this experiment we prove that while a candle will burn in ordinary air, it will not burn in an atmosphere of carbonic acid gas ; and it is equally true, that while the used up tissues in the blood will burn off in the presence of oxygen gas

they will not burn off in the presence of carbonic acid gas; and if retained in the blood, by not being burnt off, the individual will surely die. Hence the importance of fresh air as a means of purifying the blood. Whatever food we take must first pass into the blood. After it has performed its work—that of feeding the tissues—it is oxidized or burnt off in the way I have described, and is discharged from the system in the form of water, carbonic acid, and ammonia.

To keep the blood in health food *must* contain nitrogen. Every nitrogenous food consists of the elements of nitrogen, hydrogen, carbon, and oxygen. If a nitrogenous food is supplied to the body there is no absolute necessity of supplying any other, because every nitrogenous food contains, besides the nitrogen, carbon and hydrogen, which in the process of oxidation give out sufficient heat to keep up the temperature of the blood.

Albumen is the type of a nitrogenous food. The substance known as white of egg is albumen. No man can live on mineral, oily, fatty or starchy foods alone. He must have a nitrogenous food to mix with these. Now, although albuminous food is essential, and under certain circumstances may by itself maintain the body, yet it is a very disadvantageous and uneconomica food: it will not do to eat it alone.

For instance, albumen contains 53 parts of carbon to 15 of nitrogen in 100 parts. It has been proved experimentally that a healthy full-grown man keeping up his weight and heat, throws off from his body daily 4000 *grains of carbon* to only 300 *grains of nitrogen.* To get back his 4000 grains of carbon he must eat 7·547 grains of albumen. But 7·547 grains of albumen contain 1·132 grain of nitrogen, or nearly four times as much as he wants. Thus you see a man must eat a prodigious quantity of purely albuminous food to get the quantity of carbon out of it he requires.

This not only throws a great amount of labour upon the organs, whose duty it is to discharge the waste product of nitrogenous food; but the blood, becoming over-loaded with albumen food and its waste products, falls into an unhealthy condition, and is a cause of most serious disease.

From this we learn the importance of eating mixed food. A

diet, in which nitrogenous or albuminous substances are mixed with fats or oils or starchy substances, or both, is that which is most suitable for us.

Now, I must say something to you about the proper DRINK OF MAN AND ANIMALS.

The blood of all animals, which give suck to their young ones, is very similar in composition. All animals except man drink water only with their food; but man, unfortunately for himself and his offspring, drinks besides water another substance called *alcohol*—a substance which, taken in excess, will in course of time act so injuriously in his blood, that all parts of the body—the brain, the heart, and blood-vessels especially—become dangerously affected. What is alcohol? It is "strong spirits of wine." When you drink whisky, you drink spirits of wine, flavoured with some smoky material. The intoxicating part of whisky is alcohol. Whisky contains a large quantity of alcohol. Gin, rum, wine, beer, all owe their intoxicating power to the presence of this same substance alcohol, which really is nothing but spirits of wine.

Now, alcohol, or spirits of wine, when mixed with water and certain flavouring materials, forms all the strong drink, which is so largely consumed in this and other countries.

Now, I may tell you as a fact that alcohol cannot answer any one of the important purposes for which the use of *water* is required in the system, and if taken into the blood, it tends to prevent the solution of many of the substances which are so important as nutritive materials, and which ought to be taken up as food by the tissues of the living body.

Alcohol cannot supply anything which is essential to the nutrition of the body. It is a non-nitrogenous substance. Alcohol is essentially a stimulant. When taken into the body it forces the nervous and muscular systems to do work in a short space of time which ought to be done in a long space of time. All stimulation is followed by exhaustion, and weakness results.

It is a great mistake to suppose that whisky strengthens you. It stimulates, but gives no lasting strength to the body. All of you have seen a drunken man staggering and at last fall down. A man dead drunk is one whose blood and nervous system have

been poisoned by alcohol. All strong drink passes first into the blood, and then to the different organs. It is a great mistake to suppose that whisky, gin, or beer will warm you. It actually causes the blood to become colder than before. It makes the heart drive the blood to the surface of the body, and it causes the small arteries everywhere to dilate as if the whole skin was blushing. The warm, hot blood coming to the surface of the body loses a large amount of heat by radiation, and thus the temperature of the blood everywhere is reduced, and is actually colder than before. A cup of hot coffee will warm you a thousand times better than a bucketful of whisky. Alcohol also, if taken habitually for a long time, tends to make the blood-vessels throughout the entire body rotten, so that they often burst under a small strain. It also brings about disease of the brain and of the heart. It has been found that in the case of a man who drinks much alcohol, wounds heal very badly, and sometimes even a slight wound may cause his death—the blood being in a very unhealthy state. Alcohol certainly destroys the red blood globules of the blood.

Now, for these and other reasons, the habitual abstinence from alcoholic liquors is the best rule that can be laid down for the great majority of healthy individuals.

I might also have said a few words about the poisonous effects of smoking in excess upon the blood. No doubt, when tobacco is used in great moderation it is not very injurious, but, used in excess, it acts very injuriously in the blood and nervous system.

I must now, in conclusion, say a few words about the skin as an organ for purifying the blood.

An immense number of capillary blood-vessels permeate the skin in all parts, so that you cannot prick yourself with a needle without wounding some of these. A healthy, full-grown man throws off by his skin in 24 hours in the form of sweat, about 18 ounces of water, about 300 grains of solid matter, impure material, and about 400 grains of carbonic acid.

All this amount of sweat is thrown off from the blood by means of the perspiration or sweat glands which are situated in the skin. These little glands are tubular structures, and are so numerous that there are about 2800 on a square inch of the skin. On the

palm of the hand there are about 3500 of these little sweat glands. Taking the surface of an ordinary man as being equal to 2500 square inches, the number of little sweat glands will be about 7,000,000 on the surface of his body.

Each of these little sweat glands is about a quarter of an inch long. There will be, therefore, about twenty-eight miles of tubing in the skin. No one will deny that serious results must follow if this drainage system is obstructed.

These pores of the skin are constantly throwing off vapour or sweat. This evaporation from the skin serves to keep the temperature of the blood at about 100° F., and at the same time relieves the blood of a large amount of impurities. If the skin is not occasionally washed with soap and water, the sweat accumulates in the sweat glands, and these being blocked up, the blood is gradually poisoned by the waste products which ought to be thrown off by the skin. You will easily understand, from what I have said, the importance of keeping the skin clean by means of hot water and soap. It has been calculated that the air cells in the lungs, if spread out, would cover a surface 1 yard wide and 300 yards long. If we add to this 28 miles of tubing that exists in the skin, you will readily see the importance of breathing pure air, and of keeping clean skins, as the best means of preserving your blood in a healthy state.

APPENDIX.

THE BLOOD AND ITS CIRCULATION:

HOW TO KEEP THEM IN HEALTHY CONDITION.

Good Food, Temperance, Pure Air, and abundance of Exercise, are the best means of keeping the Blood and the Blood-Vessels in a healthy condition.

Infant Life.—Mothers' milk is the best food for infants.

When mothers' milk cannot be had, cows' milk diluted is the best substitute.

Milk is the only natural food for the young. It naturally contains albuminous, oily, and saccharine or carbonaceous substances, with the necessary minerals in proper proportion.

The following is an excellent food for Infants, up to the age of nine months :—Mix a large breakfast-cupful of milk with the same quantity of water. Add a dessert-spoonful, or less, of fine oatmeal, a pinch of common salt, and one or two pieces of white lump sugar. Boil the mixture for five or six minutes. Then strain through a piece of muslin. It is now ready for use.

Preparation of Food for Infants.—All mixtures of milk and water should be first boiled before they are given to infants as food. By this means the seeds of disease in impure milk and water are destroyed.

Milk a Good Food for Adults.—Pure milk should form *part* of the food of all young and growing children; and *may* form *part* of the food of all hard-working men and women. Good milk is twelve times more nutritious than beer.

All food for adults should consist of a proper mixture of—

1. Flesh-forming material—*i.e.*, nitrogenous.
2. Heat-forming material—oily, hydro-carbons.
3. Saline matters—salts of potash, soda, &c.

Pure milk contains all these materials in proper quantity, and should therefore be used as food by hard-working men and women as well as by children.

If milk is taken as food, then a smaller quantity of meat is necessary. The proper admixture of albuminous, oleaginous, saccharine, and saline constituents of food, is of the first importance.

It does not matter whether the first two of these are derived from the animal or vegetable world. All that is necessary is, that the food selected should supply the needful quantity of these substances.

Food should vary with Seasons.—Food should vary according to climate.

In cold weather a good supply of oleaginous diet should be taken.

In heat of summer less of the fatty food, but more of the fruits and farinaceous foods, should be taken.

The use of a highly animalised diet, *i.e.*, nitrogenous, has a tendency to raise the proportion of red blood globules, the use of a vegetable diet to lower it; whilst a proper mixture of animal and vegetable diet is the best for maintaining the healthy condition of the blood.

Fresh vegetables should always be used as often as possible. They supply a large amount of saline matters to the blood.

An increase of albuminous and farinaceous, or oily food is necessary when an unusual amount of muscular force is put forth.

Water is the natural drink of man.

Individuals and whole nations maintain the highest vigour and activity of mind and body without touching whisky, wine, or beer, as articles of food. Alcohol in the form of whisky, gin, wine, beer, &c., if used habitually, causes disease of the heart and blood-vessels throughout the whole body. It makes the blood unhealthy: the mortality of persons who are intemperate between the ages of 21 and 30 is five times greater than those who are abstemious. When food is ample in quantity and quality, alcohol is altogether unnecessary and injurious.

Wash the Skin.—Infants, children, men, and women, should have their bodies washed frequently to remove the poisonous matters given off by perspiration or sweat.

It is calculated that a strong full-grown man throws off from his blood in 24 hours by the sweat, 18 ounces of water, 300 grains of impure solid material, and 400 grains of carbonic acid.

ACCIDENTS, EMERGENCIES, WOUNDS, AND OPERATIONS.

By Professor ANNANDALE.

On the Evening of Saturday, 18th December, Professor Annandale delivered the fifth of the Course of Health Lectures in the United Presbyterian Synod Hall, his subject being "Accidents, Emergencies, Wounds, and Operations." Professor Annandale said :—

Ladies and Gentlemen,—

Importance of Temperance and Good Health in connection with Injuries and Operations.—You have already had, and will have, valuable hints from my fellow-lecturers which ought to aid you in preserving your health; and as accidents may occur, and operations be required at any time, I should wish to impress upon you the fact, that, if any of you should unfortunately receive an injury or have to suffer an operation, the better your health, the better will you recover from your injury or from your operation.

In my daily duties at the Infirmary and in private practice, cases of serious injury and operations come constantly under my care; and when I ascertain that my patient has been temperate in his habits and careful of his health, I feel that some of my anxiety is removed, for experience has taught me that the risks connected with the accident or operation are, under the circumstances, much less than if my patient had been intemperate or in a poor state of health.

Let me mention an instance in illustration of this remark, and of others presently to be made to you.

A few weeks ago a man was severely injured at a railway station some miles out of Edinburgh. Fortunately, he was a temperate man, and in good health; fortunately also, there was not very far away a railway porter who knew what to do and how to do it, as I hope all you will know after to-night. This porter, who himself had some years ago lost a leg in the railway service, immediately used means to stop the bleeding, had him at once carried to the Royal Infirmary, where his injuries were attended to without delay, and his right arm and right leg removed, as they were both severely crushed. In less than three weeks this man was sitting up in bed, and teaching himself to write with his left arm.

This man undoubtedly owed his life—

1. To his temperate life and good health.
2. To the prompt attention of the porter.
3. To the care and attention he received in the Royal Infirmary.

Antiseptic Treatment of Wounds.—In connection with health and sanitary precautions, I wish now to say a word or two to you in regard to what is termed Antiseptic Treatment. This treatment is founded upon the scientific fact, that floating about in the air are vegetable organisms, or germs, some of which are harmless, but others appear to be the cause of putrefaction and consequent inflammation, and suppuration or "mattering" when they come in contact, as they must do, with wounds exposed to the air. As it is impossible to prevent altogether the contact of these germs with an open wound, the object of this special treatment is to apply to the wound some form of dressing which has the power of destroying or killing them. Many substances have the power of killing vegetable organisms; but it has been found that two of the most convenient for this purpose are carbolic acid and boracic acid, and more particularly the former. The antiseptic treatment has been brought to its highest point of success by Mr Lister, and to him, therefore, is due the credit of having saved many lives and of relieving incalculable human suffering. The "Listerian" method, as it is termed, requires special appliances and special dressings, which I show you, in order that you

may be impressed by and interested in the subject; but when talking to you of the treatment of wounds, I will describe a more simple form of antiseptic dressing which can be employed by any of you.

Experience would appear to point to the fact that some atmospheres are less charged with injurious germs than others, and the day may come when science will establish a method of thoroughly purifying the atmosphere, so as to render it and its germs harmless; but, in the meantime, we must consider all atmospheres as more or less injurious, and consequently treat them to a course of antiseptics when they are brought into contact with open wounds. I will only at present remark that the facts I have referred to point to the importance of covering a recently-made wound as soon as possible, and applying to it some germ-killing solution or dressing.

General Treatment of Accidents.—Having already made the remark that accidents may occur at any time, I am anxious, in the first place, to give you a few general hints which will enable you to assist in immediately relieving persons who may be accidentally injured in your presence or neighbourhood. If you learn to do this simply and efficiently you will have the pleasing satisfaction of feeling that you have aided in soothing pain, and you may possibly, also, be able to feel that you have done something to save the life of a fellow-being.

When an accident happens—(1.) Try to keep collected and calm, and remember that the better you keep your wits about you the more likely are you to be of use to the sufferer. (2.) Ascertain if there is any bleeding, and at once check it by the means presently to be explained. (3.) Lay the patient on his or her back, or in the position felt to be most comfortable. In most cases the patient should be placed in the horizontal position; but if the breathing is affected, the sitting or partially sitting position is the best. (4.) Loosen any of the clothes which may be tight or causing discomfort. (5.) Don't give stimulants unless the patient remains in a very faint condition for more than half-an-hour, and after this time only give them in small quantities.

(6.) Should the patient feel cold, cover the body with blankets or other wraps, apply heated bricks or some warm application, unless bleeding is continuing seriously. (7.) If the patient does not show signs of recovering within half-an-hour of the injury, send for medical advice at once, or carry him or her to a hospital. It is important that all persons suffering from accidents should be carried to their home or to a hospital as carefully as possible. For this purpose, a stretcher, barrow, or mattress may be used, which will allow the patient to lie in the horizontal position. If a proper stretcher is not at hand, any board, old shutter, door, or gate may be employed, or a temporary stretcher may be made with two or more poles or pieces of wood, with canvas, wire-gauze, or rope stretched between them. It is often, also, well to keep the clothes or wraps from pressing upon an injured part by putting over it a cradle, as it is termed. This may be made of wire, of an old box, or of hoops, in the way I show you.

Treatment of Injuries to the Head, Spine, Chest, and Abdomen.—Injuries to these portions of the body have special risks, owing to the important parts which are contained in them. These contained organs may suffer at the time of the injury, or they may become affected as a result of it.

For this reason, it is of consequence that when the head or other parts mentioned are injured, special care should be taken to keep the patient as quiet as possible until proper medical aid is procured. Such injuries may be slight or serious; but in all, rest, in the first instance, is advisable until the danger or non-danger of the accident has been decided by a skilled practitioner. If the patient is thirsty, small quantities of water or milk may be given, but stimulants should not be administered, unless the patient remains in a prolonged faint condition. Should there be great pain in any special part, the application of a cold wet compress may soothe, and can do no harm.

Treatment of Bleeding.—Bleeding may be the result of a wound, or it may be caused by the bursting of a vein or artery. Such bleeding may take place externally or internally, and also

from the nose and other passages of the body; special diseased conditions, as certain ulcers or sores, sometimes cause bleeding.

When external bleeding takes place from any cause, it is naturally very alarming to a non-professional person; but I hope to assure you all, by telling you that, with very few and rare exceptions, all kinds of bleeding are easily stayed, and by showing you how to act under such circumstances. There are three different kinds of blood-vessels in the body—the arteries, veins, and capillaries—from any one of which, or from two or the whole, bleeding may come. By means of this diagram, I illustrate these different vessels, and also explain how the character of the blood and the method of its flowing vary according to the particular vessel or vessels injured or diseased. In bleeding from the arteries, the blood is bright red, and spurts out in jerks or jets, corresponding to the beats of the heart. In bleeding from the veins, the blood is dark-coloured, and flows out in a continuous stream, or in drops. In bleeding from the capillaries, the blood oozes or wells out. If more than one kind of blood-vessel is wounded, the bleeding may be of a mixed kind. When bleeding is taking place from the external surface of the limbs from any cause—(1.) Try *direct pressure upon the bleeding point*, and keep the limb raised above the level of the body. This pressure may be made with one or more fingers, or with a compress of cotton waste, a sponge, handkerchief, or any soft substance, in the manner I show you. (2.) Should this fail to stay the bleeding, apply a ligature of cloth, rope, strong twine, india-rubber cord, or any other cord at hand, as tightly as possible round the limb *immediately above* the bleeding point, and send at once for a medical man, or take the patient to him, or to a hospital. (3.) If the bleeding is from an external wound or sore on the trunk of the body, employ the *direct pressure* over the bleeding point; and if this does not stay the bleeding, send for a medical man, or take the patient to obtain proper medical aid. (4.) If the bleeding is coming from the interior of the nose or other cavity, apply cold water or ice over the bleeding part or near it, and keep the patient perfectly quiet on his or her back. (5.) When the bleeding is coming from a diseased surface or ulcer, and direct pressure does not stay it, the compress should

be soaked in a strong solution of alum, or in "steel-drops," and again applied over the point which is bleeding. Should the wound from which the blood is coming be large and gaping, you may stuff firmly into it a compress of some soft material large enough to fill the cavity. In any case of bleeding the patient may become weak or may faint, but unless the blood is flowing actively, the sign is not necessarily a serious one, and the quiet condition of the circulation during the faint often assists nature in staying the bleeding, by allowing the blood to clot, and so block up any wound in a blood-vessel. Unless, therefore, the faint is prolonged, or the patient continuing to lose much blood, it is better not to do too much to relieve the faint condition.

Bleeding may take place internally without showing any external signs recognisable by a non-professional person. The only guide to such an occurrence is a prolonged weak or faint condition following some injury or sudden illness. When this state is met with, the patient should be kept perfectly quiet and cool, and a medical man at once sent for. In cases where blood is being coughed or vomited up in considerable quantities, ice or iced water or milk should be given, and the patient allowed to breathe fresh air freely. When the blood comes from the lungs, the inhalation of the steam of turpentine and hot water mixed (two tablespoonfuls of turpentine to a quart of hot water) should be tried if other means fail.

Treatment of Wounds.—Wounds may be caused by falls, by sharp, blunt, or pointed bodies, or by tearing or crushing, so that the character and appearance of wounds vary very much. Wounds may only involve the skin and flesh without destroying any important organ, blood-vessel, joint, or bone, or they may be made serious by injury to one or more of these structures. Dirt, pieces of gravel, stone, metal, lead, glass, or other foreign body may be driven into a wound and remain there. A wound is not immediately serious owing to its extent, but according to the important parts which it implicates. When a wound has been caused by accident—(1.) Stay any bleeding in the way already described. (2.) Keep the wounded part at rest; remove any

clothing which may be pressing upon the body between the wound and the heart, and place the part in the position which best keeps the edges of the wound from gaping. (3.) If the bleeding is slight, allow a stream of cold water to flow over the surface of the wound, so as to wash away any dirt or other foreign substance. (4.) If the wound is a serious one, send for a medical man, or have the patient taken to a proper place for treatment. (5.) One of the best applications to wounds of all kinds is carbolic oil (one part of carbolic acid to twenty parts of linseed or olive oil); and therefore you may always safely apply a piece of rag soaked in this oil to the wound, and keep it constantly moist by pouring on fresh oil; turpentine, oakum, or tarry substances may be used if at hand, as they all have antiseptic properties. (6.) If portions of the skin or flesh be displaced, or if the edges of a wound be widely separated, gently replace the separated parts, and try to bring the edges of the wound in contact before applying the dressing of oil. (7.) If, in addition to the wound, bones be broken or dislocated, use means to keep the injured part at rest, as in the case of fractures and dislocations, presently to be referred to. Poisonous matter may be introduced into a wound and cause serious inflammation. Poisoned pricks and wounds of the fingers are common, and often cause the painful and troublesome disease termed whitlow. When swelling and inflammation follow such an injury, medical advice should be at once sought, as early treatment will do much to prevent unpleasant results.

Treatment of Bites and Stings.—The bite of any animal may cause simple abrasion of the skin, or one or more wounds. Unless the animal is known to be suffering from hydrophobia, there is no special risk and no special treatment connected with these injuries. Such wounds are often slow to heal, and may require soothing applications in the shape of hot fomentations, or poultices, if any irritation follows their infliction; but it is not advisable to apply caustic, as is generally done, unless the animal has shown signs of madness, or unless there is a doubt in regard to this point. Then caustic, or a hot iron or wire, should be freely applied to the wound, and a doctor consulted.

The stings of wasps, bees, and other insects require to be treated by the careful extraction of the sting when it has been left in the skin, and by the application of oil or glycerine over the injured part.

Treatment of Bruises and Sprains.—When a part of the body is bruised there is swelling and discoloration of a blue or black tint. The discoloration is sometimes not much seen at first; but in the course of a few days the surrounding skin shows various shades of yellow, blue, and red. As the swelling and discoloration depend upon some bleeding into the tissues of the body, the part must be kept at rest, and in the first instance cold applied; but when the first effects of the injury have passed off, and the part remains painful, warm fomentations are often very soothing. An excellent application to a bruised part is sugar of lead dissolved in water. One small teaspoonful of sugar of lead to a quart of water makes a good lotion for this purpose.

Sprains of muscles and of joints are often troublesome injuries to recover from. They should be treated by rest, bathing with hot water, and applying soothing fomentations in the first instance; and when the swelling is passing off, by friction and careful exercise, with the addition of the support from an elastic bandage. Experience has shown that too prolonged rest in these injuries is not advisable; and, therefore, patients should not delay the exercise too long, otherwise stiffness of the muscle or joint may result. Before deciding the question of exercise in a case of severe sprain, is will be well to consult a medical man, because I should wish you to know that in weak or unhealthy constitutions such injuries may be followed by disease of a joint or other condition, which might be made worse by movement.

Treatment of Fractures and Dislocations.—When a bone is broken or dislocated, careful handling of the injured person is of great importance. Should a patient suffering from such an injury be roughly or improperly interfered with, the accident may not only be made more serious, but much unnecessary pain may be caused.

You judge that a fracture has taken place by the distortion, pain, and too great mobility of the part; and in a dislocation the part is distorted and fixed in some unnatural position.

A fracture should be treated—(1) By carefully removing or cutting away, if more convenient, any of the clothes which are compressing or hurting the injured part. (2.) By very gently replacing the bones in their natural shape, or as nearly so as possible, and by putting the part in a position which gives most ease to the patient. (3.) By applying some temporary splint or appliance, which will keep the broken bones from moving about and tearing the flesh. For this purpose you may use pieces of wood, stick, tin, pasteboard, wire, straw, or firmly folded cloth in the way I show you, taking care to pad the splints with some soft material, and not to apply them too tightly to the parts. The splints may be tied to the part by loops of rope, string, pocket-handkerchiefs, pieces of cloth, or any kind of cord. (4.) The patient should then be carefully taken home or to an hospital, and medical advice obtained. Should medical advice not be procurable for some hours, examine the loops and see that they are not too tight, as rapid swelling of the part may cause them to become injuriously tight very quickly.

Cases of dislocation will be best treated by placing the patient and the injured part in the position which gives the most ease, and, by obtaining medical aid, to put the dislocated bones into their proper situation.

In fractures and dislocations, complicated with one or more wounds, the wounds must, in addition, be treated as already explained. Where a wound does exist, it is of consequence that medical aid should be sought as soon as possible, for special operations may be necessary in such injuries.

Bone-Setters and Bone-Setting.—It is not my intention or wish to abuse those who are called "bone-setters." Many of them and their followers, I believe, are conscientiously of opinion that they possess some extraordinary knowledge of bones and joints, and have some mysterious power in making a bone, joint, or sinew do their bidding; and I do not for a moment deny that there are cases which may be benefited by their manipulations.

My experience is, that some of these practitioners discover bones —small ones especially—of which the most skilled anatomist is ignorant, and that they frequently decide that such unknown bones are "out;" whether or not it is possible to "put in" bones which do not exist, I leave to your judgment to determine.

Any of you are capable of treating a simple case of fracture or dislocation on common-sense principles. You might or might not be successful; but if you were successful, it is possible that your friends would proclaim you a born bone-setter. If you were unsuccessful, you would not be blamed, as it would be said that you could not be expected to know any better. The cases in which so-called bone-setting may do good are—(1.) Simple cases of fracture, dislocation, or sprain. (2.) Cases in which joints, sinews, or muscles have become stiffened and glued together from injury or other cause. (3.) Cases in which the imagination of the patient is principally at fault, and which require some active and impressive treatment to act beneficially on the mind. The energetic manipulations of bone-setters sometimes succeed in these classes of cases; and if we, members of the profession, would be a little more energetic in our treatment of such patients, irregular bone-setting would no longer be required. Seriously also, I say to you, that while experienced surgeons may be able to tell of a few patients relieved by bone-setters, they can tell of very many who were not cured, and who were permanently injured by improper treatment.

Let me also say, in regard to this subject, that complete recovery after a bone has been broken or dislocated is often slow, even if the bone be healed and in its right place, owing to the injury done to the muscles and sinews; and therefore if some weakness, stiffness, and swelling remain for a time, you need not be alarmed, but persevere with exercise and movements of the parts, rubbing with oil and bathing with hot water, which are the best means of relieving these conditions.

Treatment of Burns and Scalds.—Burns and scalds are dangerous, not only from their depth, but also from their extent, and the part of the body which they involve.

Even slight burns and scalds, if they involve a large surface,

and especially if they are situated on the head, chest, or abdomen, are often serious. Burns and scalds are also more dangerous in young children and in old people.

In treating a burn or scald—(1.) Remove as soon as possible any burnt or heated clothing or other substance which may be in contact with the body. (2.) If the burn or scald is a slight one, wrap the part in dry cotton-wadding. (3.) If the burn or scald is extensive, apply cotton-wadding to the whole surface, and if there is much pain send for some carron oil—or, if there is at hand, any sweet or linseed oil—and soak the cotton-wadding with it, and renew the oil from time to time so as to keep the parts cool and moist. (4.) Should a burn appear to be deep, apply the cotton-wadding and carron, or other oil, until medical aid is sought.

These dressings are the best for temporary purposes, but medical advice should always be got as soon as convenient, for special treatment and applications may be required in any case. It is always well to protect the injured part from exposure to the air, and if the patient remains weak aud faint same hot soup, gruel, or small quantities of stimulants should be given. Children sometimes receive a serious scald of the mouth and throat by swallowing hot fluid, or steam from the spout of a kettle or other receptacle. In these cases medical assistance should be obtained without delay, as an immediate operation may be required to prevent the patient dying from suffocation. Until the arrival of the surgeon the patient should be made to inhale warm and moist vapour, so as to relieve the fits of choking. The best plan to cause a person to inhale a warm and moist vapour in such cases, or in cases of croup, is to make a kind of tent of blankets or rugs over the patient, and allow the hot steam from a kettle to puff into it.

Lodgment of Foreign Bodies in the Eye, Ear, Nose, and Throat.—Particles of dust, flies, small portions of stone, metal, or other substance, may lodge under the eyelids and give rise to much irritation? These should be removed as soon as possible with the folded corner of a handkerchief or any convenient instrument, and I know that many of you become experienced in the removal of

such bodies from the eyes of your mates and friends. If much dirt or dust has been forced under the eyelids, it is usually best removed by syringing the eye with a little tepid water. If, after the removal of the foreign body, irritation still continues, a few drops of sweet oil dropped between the lids usually give relief, and if it does not, a cold, wet, compress should be applied over the eye. Hot lead, lime, or other matters likely to burn or irritate the eye, sometimes strike one or both eyes, and may lodge between the eyelids. These should be at once removed, the sweet oil dropped into the eye, a wet compress applied, and medical advice taken.

When the eyeball itself is injured or wounded by foreign bodies immediate surgical advice is important in connection with the preservation of sight.

Children not unfrequently introduce into their nostrils pieces of slate pencil, small stones, pieces of wood, beads, or other bodies. This accident is in no way serious, but the presence of the body may cause, in the first instance, bleeding from the nose, and afterwards a discharge of matter. It is best to consult a medical man and request him to remove the body, as unskilful attempts to lay hold of it may force it higher up into the nose, from whence it may be more difficult to remove it.

Bodies similar to those passed into the nose, and sometimes also flies and other insects, may be introduced into the ear. Unless rough attempts are made to remove these bodies, they rarely cause bad results; but if such cases are improperly handled, the body may be forced against the drum of the ear, so as to injure it, and lead to some impairment of hearing. It is wise, therefore, not to interfere in such cases, but to trust to proper medical aid. The only safe proceeding—if medical assistance cannot be easily procured—is to carefully syringe out the ear with tepid water, and this will sometimes wash out the foreign substance. If an insect has lodged in the ear, a little oil should be dropped into its cavity. Portions of meat or other food, fish or other bones, artificial teeth, or other foreign substances, may lodge in the upper part of the throat, and cause symptoms of suffocation. Life may be saved in these cases by introducing one or more fingers into the patient's throat, and pulling out the foreign body, so as to take away the

pressure from the upper part of the wind-pipe. Small coins, beans, peas, and other bodies may be swallowed, and pass into the wind-pipe itself, and cause cough and symptoms of suffocation. In such accidents medical aid should be at once summoned, for fatal choking may take place at any moment.

TREATMENT OF DROWNING, STRANGULATION, AND POISONING.—When a person has been immersed in water long enough to cause insensibility, he or she should (1) Have the mouth opened, and the tongue drawn forward; and any dirt or other substance which may be lodged in the mouth or upper part of the throat removed, (2.) If possible the patient should be at once removed to a warm room, any wet clothes taken off, and artificial respiration in the way shown to you commenced. Should a warm room not be at hand, any dry clothes or wraps which can be procured must be placed over the patient when his or her wet clothes have been taken off; and the artificial respiration begun and diligently carried on. At the same time, friction with the hands should be applied to the surface of the body. The artificial respiration should be persevered in for an hour at least if the patient does not recover before this. If sensibility and breathing return, the patient should be kept warm, and small doses of stimulants given.

When a person has been subjected to strangulation, the treatment required is:—(1.) The removal of any ligature or constricting agent from the neck. (2.) The employment of artificial respiration if the patient is insensible. (3,) Friction of the surface of the body. The inhalation of certain gases, as from old wells, vats of breweries, and mines, gives rise to symptoms closely resembling those caused by strangulation, and requiring similar treatment, with the addition of dashing cold water on the surface of the body.

When a poison has been swallowed, the particular symptoms depend on the nature of the poison swallowed.

The general treatment of all cases of poisoning may be said to be—(1.) To get rid of any of the poison which may have passed into the stomach. This is done by giving emetics, such as copious draughts of warm water or of mustard and water, and by using the stomach-pump. (2.) By swallowing bland fluids, which will dilute the poison and lessen the risk of its acting injuriously upon

the stomach and other internal organs. The best fluids to swallow under these are warm water, milk, chalk, magnesia, sweet oil, and white of egg. (3.) To apply friction to the surface of the body if there is coldness or tendency to insensibility, and endeavour to keep the patient awake by exercise or other means. (4.) In all cases of poisoning, send at once for a medical man, and mention to him the nature of the poison, if known, so that he may bring with him proper antidotes or remedies.

Treatment of Fainting, Fits, and Sudden Illness.—When a person faints—(1.) Lay him or her flat on the back, with the head somewhat lower than the body. (2.) Loosen any article of dress which feels tight. (3.) Should the person have fainted in a heated room, or under some exciting cause, he or she should be at once taken into the fresh air or removed from the exciting circumstance. (4.) Should the faint condition not soon pass off, dash cold water on the face and chest, and hold smelling salts or other stimulating vapour near the nostrils. (5.) Should consciousness return and the patient remain still very weak, give a small dose of any stimulant which is at hand, and repeat it if necessary. (6.) Should the patient's faint condition remain, continue the same treatment, and seek medical assistance without delay.

If a person is attacked with a fit or sudden illness, attention to the following rules is advised—(1.) Lay the patient on his or her back, and loosen any portion of the dress which may be constricting the neck or chest. (2.) Should the patient be restless and tossing about, take precautions that he or she does not sustain injury. (3.) If the fit does not soon pass off, obtain proper medical advice, and in all cases keep the patient quiet, and in the horizontal position, unless the patient breathes easier or feels more comfortable in a different position. (4.) Should great pain be complained of in any special part, the application of a hot poultice or fomentation over the painful part will often give relief. In cases of complete insensibility, which most frequently points to serious head affection, the application of ice or other cold dressings to the head and perfect rest are most likely to be useful.

Treatment of Ruptures, Varicose Veins, and Ulcers of the Legs.—Working-men, and especially those employed in certain occupations, are liable to suffer from these affections; and therefore I wish to say a few words on the best treatment for their relief.

A rupture is a swelling which depends upon a weakness or giving way of the parts which cover in the abdomen. This swelling is caused by a protrusion of a portion of the gut or other organ through the weakened part, which pushes the skin and other structures forward. The danger of such a condition is that the gut may become caught or nipped by the margins of the opening through which it protrudes, and so cause a stoppage in the canal of the bowels, and mortification of the part which is caught. The most common situations for rupture are in the groin and front of the abdomen; and therefore when a swelling occurs, or a feeling of weakness is felt in these situations, it should never be neglected. Such a swelling is distinguished by the fact that it is moveable, and generally disappears when the person lies down, or when it is gently pushed back into the cavity of the abdomen. In this state the proper treatment is the application of a truss; but medical advice should be taken as to the necessity for, and particular form of truss. When this kind of swelling becomes painful, and more especially when, in addition, it remains fixed and cannot be pushed back, medical advice should be at once sought, and, in the meantime, the patient should rest in the horizontal position, and apply a cloth soaked in cold water over the swelling.

Early recognition and treatment of a rupture is of the greatest consequence; and therefore swellings in the regions I have mentioned should be examined as soon as noticed by a qualified medical man. Ruptures most frequently are gradual in their formation, but sometimes a sudden strain or exertion will cause a rupture to form immediately.

Varicose veins of the leg are a not uncommon cause of trouble, and are especially liable to take place in persons who stand much, or who specially use their legs in their particular occupation. They are also caused by anything likely to press upon or obstruct

the large veins in the leg or those inside of the body. The condition is not serious in itself, but it may give rise to weakness and painful aching of the legs, and also interfere with the proper circulation of the blood, and so lead to an irritable state of the skin, or to sores and ulcers. Occasionally a varicose vein of the leg gives way, and serious bleeding may take place if direct pressure and elevation of the leg are not at once used to stop it.

When the veins of the leg show any tendency to become enlarged, don't delay using means for their relief, as early treatment may do much to prevent the condition becoming worse or troublesome. The treatment advisable is—(1.) Relieve any tight garter or other article of dress which is likely to be interfering with the circulation of the blood. (2.) Rest the affected limb or limbs whenever you get the chance by keeping them raised above the level of the body. (3.) Apply some soft and gentle support, such as an elastic bandage, round the leg. (4.) Gently rubbing the affected limbs in a direction upwards towards the body will also assist the circulation and be useful. (5.) Should these simple means not give relief at once, consult a medical man, as some special treatment may be advisable.

Ulcers or sores on the legs give rise to much discomfort, and often interfere with a person's work and usefulness. They may be caused by varicose veins, or by any other cause which weakens the circulation—by wounds, bruises, burns, scalds, and by an unhealthy state of the constitution. If the ulcer or sore is neglected, the condition may become most unpleasant, and the healing slow and difficult. A little care, rest, and attention when the ulcer or sore is small or commencing will often be the means of thoroughly healing it, and so preventing a very distressing trouble. Whenever, therefore, a sore affects the legs, seek medical aid without delay; and above all things, rest the limb, and have proper treatment applied to the part. These sores are most frequent below the knee, and if you suffer from such a sore, and cannot completely lay up, you may rest the part by using an ordinary wooden leg or stump, on which the knee rests. In this way the leg, instead of hanging down, projects behind, and is kept at rest, and in the horizontal position.

Treatment of Patients after Operations and Accidents.—When a person has undergone an operation or received an injury, his or her progress and recovery depend much upon proper nursing and attention. Should any of you feel that a person in whom you are interested cannot receive this attention at home, I have no hesitation in advising that he or she should be received into and treated in an hospital.

If it is decided that the patient be treated at home, the following rules must be attended to:—(1.) A convenient and, if possible, quiet room, in regard to which the medical attendant should be consulted, is to be prepared for the patient. (2.) One relative, friend, or nurse should be selected, and should be made responsible for the nursing and general treatment of the patient; and she alone, or some one deputed by her, should receive the medical attendant's instructions. (3.) The responsible person, or her deputy, should keep a careful note of the patient's progress; should regularly and carefully administer the medicines, food, and other treatment advised by the medical attendant. (4.) Any one undertaking the care of a sick person must be prepared to encounter and to bear with irritability, peculiarities, and even fits of temper on the part of the patient, the result of his or her sick condition; and must endeavour to go about quietly, and do anything that requires to be done gently and cheerfully. (5.) Keep the air of the room as fresh as possible. Perfect cleanliness as regards the patient and everything in the room, will aid much in keeping the air sweet and healthy. (6.) If a patient's condition requires him or her to lie in the horizontal position for some time, the back and other prominent parts upon which the body lies should be from time to time examined in case bed-sores be forming. When the skin over these parts becomes tender or broken a piece of linen rag or lint smeared with lard or some simple ointment should be applied over the part, and retained by one or more pieces of sticking-plaster.

Hints to Parents on the Prevention of Deformities and Joint Diseases in their Children.—Children with bowed and deformed legs are sights too common in our streets, and as these

conditions are preventable, this should not be so; and I hope that the following hints may aid you in diminishing the number of such cases. I do not refer to cases of deformity which exist at the time of birth. The bones in many young children are for a time soft and pliable, and, therefore, in such cases the bones of the legs are not able to bear the weight of the body, head, and arms without bending or becoming distorted in one direction or another. This bending may take place without any pain. When such distortions are observed the following means should be at once taken to counteract them:—(1.) Prevent the child bearing the weight of the body on the legs. This may be done either by not allowing the child to stand or walk—no easy matter as you parents well know—or by applying some mechanical support to take off the weight of the body from the legs. (2.) Give the child nourishing food and open air exercise, and if the health is not good seek medical advice. (3.) If much distortion has already taken place some simple mechanical means may be applied for the purpose of gradually rebending the limb, but this can only be successful if the treatment is used before the bones have become hardened. After this a surgical operation is the only remedy.

Young and growing girls and boys who are put to some trade or business which keeps them on their feet, not unfrequently suffer from a giving way of the arch of the foot. While this process is going on the foot or feet ache much, and if treatment is not employed the condition of flat-foot results. The proper treatment of this condition is—(1.) Endeavour to arrange that the boy or girl does not stand or walk so much on the feet, but gets some rest daily. (2.) Have the boots or shoes made to fit properly, and with the addition of a pad of cork or india-rubber placed in the inside of the sole so as to support the inner part of the arch of the foot. (3.) If there is much aching or pain apply a cold wet compress over the foot every evening, and leave it on all night.

In connection with the proper development and usefulness of the feet, I would remark that it is the duty of parents to pay some little attention to the shoeing and booting of their children. Corns, bunions, and other troublesome conditions of the feet which may interfere much with a person's comfort and progres-

sion and occupation are too frequently the result of ill-fitting boots and shoes. A little attention to this point, and a little more money spent on these articles of civilisation, will not be lost capital, but the interest will be reaped in the future. I am even inclined to say, rather no boots or shoes than ill-fitting or improper ones.

Another kind of deformity, the result of weakness, without any actual disease, is a twisting or curving of the spine to one side. This condition sometimes occurs in men, but is more common in young girls and women. Anything which causes the patient to keep the spine twisted for a time will give rise to this distortion. Thus a habit of sitting or standing awkwardly, certain occupations, lameness in one leg, and carrying babies and heavy parcels, are common causes.

It is very important that this deformity should be early recognised and treated, otherwise the spine may become permanently twisted. When any bending of the spine or tendency to it is noticed, medical advice should be taken; and if the deformity is slight, and no disease present, proper treatment will usually relieve the deformity. The treatment useful in simple curving of the spine is—(1.) To avoid any cause which is producing or aggravating the deformity. (2.) To rest on the back, chest, or side for a certain time daily. (3.) To practise gymnastic exercises likely to strengthen the muscles of the arms, shoulders, and back, such as hanging or swinging by the hands with the feet off the ground, and light dumb-bell exercises. (4.) To attend carefully to the general health, and to seek medical advice if it is affected. Aggravated cases of spinal distortion require special supports and treatment.

Our boys and young men have their football, cricket, and other athletic exercises, and have also parks to practise them in; and it is of as much consequence that our girls and young women should have gymnastic or other exercises. I should wish to see some hall or gymnasium established where, under proper superintendence, our girls and young women would have regular and proper exercises, so as to develop their figures, strengthen their bones and muscles, improve their health, and fit them more

thoroughly in the future for the important duties which, as wives and mothers, they may be called upon to fulfil.

Diseases of the joints are of very common occurrence; and in many instances these conditions are aggravated or rendered serious by the want of a little care and attention at the commencement of the affection. Although a weak or unhealthy state of the constitution may cause joint disease, most frequently some injury is the active agent in producing the condition. Even a slight injury of a large joint may, if care is not taken, be followed by disease; and therefore, when a child receives any hurt to a large joint, precautions should be employed to prevent this risk. The principal precautions to be taken are:—(1.) To keep the injured joint perfectly at rest; (2.) to apply warm and soothing fomentations to the injured part; and (3.) to consult a medical man as to the condition. When a child complains of pain in a bone or joint, and is seen to move the limb or joint with stiffness or difficulty, a medical opinion should be obtained without delay; for, if the case is one of joint disease, the want of treatment for even a day or two may cause the condition to become aggravated or serious. Should medical aid not be at hand, it would he a wise precaution to keep the injured joint at rest until it is obtained. It is well also that you should know that diseases of the joints are often tedious, and may require prolonged care and treatment.

A few Words on our Royal Infirmary.—In concluding these practical hints, I ask your leave to make a very few remarks on our noble Infirmary.

This is neither the time nor the place to appeal to you for money, but I have no hesitation in asking you for your sympathy and confidence in connection with this institution. I know that hard words are occasionally used, and unpleasant impressions sometimes arise in regard to the work which is done there, and much pain is given to my colleagues and myself when such words or impressions come under our experience, more particularly as we feel that we freely give our time and energies to the performance of the various and laborious duties which as physicians and surgeons we are called upon to perform. When I remind you that

from 16,000 to 18,000 patients are every year treated by us, it may assist you to understand the amount of work which is performed, and it will also, I hope, explain to you how it may sometimes, but quite exceptionally, happen that a patient is apparently treated with carelessness and neglect. I say apparently, because when these so-called cases of neglect are inquired into, it will usually be found that the circumstances depend either upon some misunderstanding, or are only such as may and do occur in any institution where so large and various a community is collected together.

However much, therefore, a few and inexperienced individuals may be prejudiced against the Infirmary, I know from large experience this fact, that not more than one or two in a thousand who have been patients, and experienced the benefits of the Infirmary, have any other feeling towards it and its medical staff than that of gratitude and appreciation. Some of you, perhaps many of you, have had friends in the Infirmary as patients, and I feel confident that their opinion and experience will confirm my statement. If any of you should hear opinions expressed unfavourable to the Infirmary, I ask you, as a duty, to inquire the reasons and foundations for such expressions. If they are founded upon true facts, bring these facts at once under the notice of the Infirmary authorities, and I am certain that they will receive proper attention. If no proper reasons or facts can be obtained, then you are also in duty bound to take the part of the Infirmary, and expose the fallacies of its detractors. The New Infirmary is open to you all, and as there are now no infectious diseases treated there, go with your wives and families, at the appointed hours, and see for yourselves the patients, their comfort, and their contentment.

Such a visit will do you and yours good in every way, and will aid in exciting and increasing your sympathy for your suffering fellow-men and women.

APPENDIX.

On Accidents, Emergencies, and Operations, with Simple Lessons in connection with their Treatment.

If persons are temperate and careful of their health, they will suffer less, and recover more surely, from the results of accidents which may occur to them, and from any operations which they may require to undergo.

Accidents.—When an accident of any kind takes place, attend to the following rules :—

1. Try not to "lose your head," and remember that a little efficient aid from you may assist in saving the injured person's life.

2. Lay the person on his or her back, or, if the breathing is affected, in a partially sitting position, taking care to support properly the back and head.

3. Loosen any of the clothes which are tight or causing discomfort.

4. If there is a wound, and bleeding from it is taking place, press your fingers, a folded handkerchief, or any soft substance made into a ball, upon the bleeding part, and keep up the pressure until medical aid is obtained. If this pressure does not stop the bleeding, and the wound is on any part of the legs or arms, tie a cord of rope, twine, or anything at hand, tightly round the limb a little above the wound. This cord should be tied as tightly as possible.

5. If the person is cold, cover him or her with warm wraps after you have stopped the bleeding.

6. *Don't give stimulants,* unless the person remain very weak and faint, for half-an-hour after the accident. If after this time the faint continues, one or two teaspoonfuls of any stimulant at

hand should be given. When thirst is complained of, a little cold water, milk, or simple effervescing water, is the best drink to give.

7. If the person does not recover in half-an-hour, or if there should be bleeding or any other bad symptom, send at once for medical aid, or carry the patient to the nearest hospital or dispensary with great care.

8. When bones are broken or dislocated, handle the injured parts with gentleness, and place them in a position which gives most ease to the injured person. If the person has to be carried home, or to a hospital, before medical aid is obtained, use some simple means, such as one or more pieces of wood, wire, pasteboard, or folded cloth, and apply them so as to steady the injured part, and prevent the broken bone tearing the flesh.

9. It is well to cover all wounds as soon as possible, for exposure to the air may do harm—rags or other cloth soaked in carbolic oil (made by mixing one part of carbolic acid to twenty parts of linseed or olive oil), sweet oil, or any tarry fluid or turpentine, are the best applications to wounds until medical aid is obtained. If none of these are at hand, rags wet with cold water should be used.

10. When a part is severely bruised, apply to it cloths soaked in cold water, and renew them every half-hour until medical advice has been taken.

Treatment of Burns and Scalds.—1. Remove as quickly as possible any burnt or heated clothing or other substance in contact with the skin.

2. Cover the burnt part at once with dry cotton wadding or any other dry soft substance. If there is any sweet oil, fresh lard, or butter at hand, soak or smear a piece of soft rag with it, and apply this rag next the burnt part, and then cover it over with the dry cotton wadding or other soft substance.

3. If the burn is extensive or serious, send at once for medical aid, and should the person remain faint, give a teaspoonful of any stimulant occasionally.

Emergencies—1. When persons *Faint*, lay them on their back

with the head slightly lower than the body. If this does not relieve the *faint*, let them have fresh air, loosen any tight clothing, dash a little cold water on the face, and place smelling salts, a little pepper, or other irritating substance, near the nostrils. If the *faint* continues, send at once for medical aid.

2. When persons take a *Fit*, lay them on their back, and prevent them injuring themselves should they be tossing about. If the *fit* does not soon pass off, send for medical aid, or carry them carefully, in the lying position, to the nearest hospital.

3. When persons have been *Poisoned*, get the stomach emptied as soon as possible by giving warm water and mustard and water, and then make the person drink freely milk, chalk and water, white of eggs, or magnesia. Send at once for medical aid, and if the patient is insensible, dash cold water upon the body, and rub with the hand the surface of the body.

4. When a person has been *Drowned*, and remains insensible, open the mouth, draw forward the tongue, remove any dirt or other substance that may be in it, apply heat at once to the body, try and work the chest (artificial respiration), and rub with the hand the whole surface of the skin.

5. When a person *Chokes* while eating, introduce one or more fingers into the mouth, and try to pull out or push down any portion of food which may be sticking in the throat.

Treatment of Persons Suffering from Accidents or Operations :—

1. Choose a convenient, airy, and quiet room, and have it properly prepared for the patient.

2. *One* nurse, relative, or friend, should take the entire charge, and carry out, regularly and strictly, the doctor's instructions as to diet, medicine, and other treatment. If necessary, the person in charge may depute another to act in his or her place at convenient times, but no one else should interfere.

3. Keep the patient, clothing, and furniture as clean as possible, and do not allow anything offensive to remain in the room.

4. Move about the room quietly, be gentle and cheerful in your attentions, and try to bear calmly any irritability or temper on the part of the patient.

HINTS TO WOMEN REGARDING THEIR HEALTH, HABITS, AND OCCUPATIONS.

By ANGUS MACDONALD, M.D.

This subject is a wide one, and embraces in fact the whole sphere of woman in life and society. Such a broad view of the matter is inconsistent with the limits of a single lecture. Accordingly, it behoves me, in the endeavour to be as useful as I can, to select a few salient points and direct your attention to them. In doing so, I propose to consider certain points that affect more especially—

1st. The Girl.
2d. The Young Woman.
3d. The Married Woman and Mother.

Habit is well called second nature. Our habits rapidly become part of our ordinary selves. Our actions tend to repeat themselves —we passing gradually from the position of masters to that of slaves to our habits.

It is, therefore, of the first importance that we should early form regular and proper habits, and conduct our lives and conduct according to the moral and physical laws of our being, and not in violation of these.

Observation of the laws of health is, I need scarcely remark, equally necessary for men and women.

But with the conditions of health common to both sexes, I have

nothing to do at present. They form the burden of other lectures in this course.

I am charged specially with those matters which concern woman as woman, and which are indeed peculiar to her sex. As these subjects require to be handled with some delicacy, I deemed it prudent to avoid having a mixed audience. In that way I hoped to be able to speak to you with greater freedom, and to avoid entirely any embarrassment on your part or mine.

1. The Girl.—From birth upwards we see in the female the impress of feminine instincts that distinctly separate her from the male, and indicate her fitness for her particular sphere and duty. Thus, the little girl takes particular pleasure in playing with her doll, and cares for it with a motherly solicitude and anxiety; whilst her brothers as naturally take to playing at horses or some such boisterous amusement, in which their sister can only be persuaded to take an occasional and fitful interest.

The loving, receptive, and clinging nature of the girl develops to the careful observer in contrast with the wild, adventurous, but withal energetic nature of the boy. Train a girl among a family of boys, and let her see nothing but their ways, she may grow up a good bit wild and rough, but her girlish tendencies nevertheless find their way to the front, and constantly exert their influence upon her brothers, as they upon her. The object of training is not to eliminate the feminine tendencies in the girl, for these are her crown and glory,—it ought to foster, regulate, and refine them,—to prevent the over-development of any single quality, and to bring the whole tenor of her being into harmony.

We should endeavour to make our girls as perfect girls as possible, so that they may grow up good and useful women and mothers, in the same way as we endeavour to make our boys as perfect boys as possible, that they may, when they grow up, prove themselves good and useful men. But as feminine tendencies manifest themselves early, we understand that, from her tenderest years, the girl requires special care and attention, if she is to develop into a useful woman.

Much of the misery of after life, and many deaths of children and of mothers, result from neglect of practicable precautions in the management and upbringing of little female children. If a man happens to suffer from a deformity, such as a hunchback or a short leg, we commiserate him on his misfortune, and this we do with all due sincerity. But in his personal misfortune all his ills terminate. It does not, or at least needs not interfere with his enjoyment of life or with his usefulness, and certainly does not endanger his existence.

Such is not the case with the woman. Any deformity in the skeleton of the girl is extremely apt to be propagated to her bony pelvis. When that is so, it either entirely unfits her for giving birth to living children, or makes her deliveries so severe and dangerous, that she is exceedingly likely to succumb before the termination of child-bearing life to some of the many complications that arise from the pelvic defect, or the artificial means needed to effect delivery. The results to the offspring of a woman with an ill-formed pelvis are still more disastrous, ending often in unavoidable death at delivery, or in mutilation and permanent injury. It is, accordingly, of the greatest importance that the skeleton of a girl should be symmetrical and well-formed to avoid those disastrous consequences.

The law of selection that lends a preference in marriage to the well-formed and well-favoured woman, no doubt, if universally acted upon, has its aspect of benevolence to the unsymmetrical and ill-formed, and is not altogether unkind to them. But, on the other hand, affection cannot always be regulated by the cold laws of physiology and logic; and it is therefore of importance for mothers, in the training of their girls, to avoid, by all means in their power, the causes that tend to stunt or deform the skeleton of their daughters.

The most common disease that leads to deformity of the bony tissues is rickets. This is a disease of early childhood, depending, so far as we understand its cause, essentially upon some defect in the nutrition of the child, and resulting in abnormal softening and flexibility of the bones, out of which arise numerous deformities in

their shape. It will, therefore, be incumbent upon you to attend with care to the rules which Dr. Underhill is to give you for the feeding of young children, so that the essential cause of this cruel disorder may be combated at the outset.

Then supposing the disease should occur, care ought to be taken by diligent application for medical advice, to make the attack as mild as possible, and to avoid gross deformity of the pelvis, by discouraging the child from attempts to move about whilst the bones are soft and flexible.

But even when the bones are not unnaturally soft through deficiency of earthy matter as in rickets, a female child, if compelled to carry weights that are too heavy for her, may thereby have her pelvis deformed by simple pressure of this weight, and that of her trunk upon the pelvis. This heavy kind of work ought therefore not to be assigned to girls.

The observation of the general principles of health ought to be strongly impressed upon parents in dealing with their girls. Boys by playing at foot-ball, cricket, &c., have abundance of opportunities to develop their muscular system, and to lay the foundations of a healthy constitution. But nothing like corresponding concern is bestowed upon our girls. Among the well-to-do classes of society, it is reckoned by prudish governesses unlady-like for girls to romp about freely in a public park; and, among the poorer classes, the unfortunate girl is kept tending baby or looking after domestic duties, varied perhaps with the questionable amusement of running an errand. In consequence, the lungs of the girl are only seldom filled with the fresh air of heaven, and her circulation is never excited by the healthy stimulus of exuberant physical activity. If more attention were paid to the physical development of our girls, we should have fewer delicate wives and daughters, and the whole race would be stronger and healthier.

I do not wish them to engage in football, or in cricket, but I do contend for more use of the skipping-rope and of their legs, and for much more out-of-door amusement, so that the girls' muscular systems should be better developed, their blood better aired and richer. In

this way, they would be enabled to enter upon the trials of life with robuster health. The more perfectly the girl's physical nature is developed, whether with walking, running, calisthenics, or otherwise, the more likely is she to turn out a useful woman, and a happy and healthy wife and mother. The attention paid to the physical training of boys is very considerable, but, so far as I can judge, not a bit too great. But little is done for girls in that direction. It is assumed that they do not need it. But this is a great mistake and ought to be remedied.

The emotional and imaginative nature of the girl is particularly sensitive and mobile. Consequently, care should be constantly exercised that these qualities of the mind should not be over-stimulated. Young girls should be kept, as far as possible, from disagreeable sights, and from any prolonged excitement, likely to wear out their nervous system, and land them in a condition of after-depression. Music itself, that charm of life, is frequently too severe a trial for a sensitive girl if much indulged in. It is apt to add to the natural too great sensitiveness, and to develop morbid feelings. But the best protection against the supervention of those irregular nervous phenomena, which, in their collective capacity, we are wont to style Hysteria, and which so greatly trouble the female sex, is the cultivation of a sound physical frame, conjoined with the necessary moral training.

The cultivation of the habit of self-restraint, of self-denial, and the necessary attention to the calls of duty on all occasions, form elements that can never be left out, without serious injury in the training of either girl or boy.

Premising now that it is of great importance in the upbringing of a young girl to attend to her moral training and physical health, and especially to the maintenance of a sound frame and healthy well-formed skeleton, we now proceed to consider some points that require special notice when the girl passes from the state of girlhood to that of the young woman.

2. THE YOUNG WOMAN will always demand special attention from her friends, whatever care is bestowed upon or withheld from the

young girl. At this time of life, the girl begins to awaken to the consciousness of her sex. Mental feelings of coyness and modesty, to which she had previously been a complete stranger, begin to develop themselves. Her physical appearance at the same time alters —she becomes plumper and rounder, and changes from the shape of the girl to that of the woman.

MENSTRUATION.—The appearance of the monthly periods marks the completion of the transition from girl to young woman. Much attention and care is needed by young women at the first appearance of the monthly flow. I should advise all mothers to warn their daughters of the near approach of this phenomenon, so that neither the symptoms which ordinarily precede it, nor the flow itself may cause them either consternation or distress. This is a point on which many mothers, from feelings of false delicacy, are frequently remiss in their duty towards their daughters. Particular attention ought to be paid to the first few menstrual periods, as in proportion as these are safely and painlessly passed much of the future comfort and happiness of the woman throughout her menstrual life depends. Every one conversant with these matters knows how painful menstruation is apt to repeat itself throughout menstrual life, if it is neglected at first, and how intractable it may become. Accordingly, it is seen how necessary it is, by strict attention to hygienic principles, to safely tide over the earlier periods, so as to avoid such a mournful catastrophe as a life of recurrent paroxysms of pain. It is also agreed, that it is much more easy to cure painful menstruation at first than afterwards.

I should like to be allowed to state, in this place, that the monthly flow ought to pass painlessly, and with little or no discomfort. It is necessary to state this pointedly, as I constantly meet with patients, who observe, on being questioned, that they experience only the usual feelings of distress at these times, assuming that the phenomenon is necessarily painful. This is not the place to lecture upon the diseases of women, but I might be allowed to observe in passing, that, among the more common causes of painful menstruation, are (1) weak health, conjoined with a nerv-

ous temperament; and (2) congestive or inflammatory affections of the womb or parts adjoining it.

We cannot alter a woman's inborn temperament, but we can train up a girl by physical and moral means so as to educate her whole being properly, in order that she may possess a sound mind in a sound body, and by avoiding all causes of over-excitement and nervous exhaustion, we may take all possible precautions that, at this particular and all-important period of her life, she may meet the struggle with as little morbid nervous action as possible. It is not well-developed, strong, healthy girls that give way to these disturbances in the region of the nervous system. It is your puny, unhealthy, ill-nourished ones. Among the classes of society, in which life is easier, these sufferers read novels of an exciting character, are highly æsthetic, much given to music, and but little to healthful exercise and bodily exertion. Among the classes of society, where such nonsense is not allowed, the sufferers are the ill-nourished, puny, ill-housed, self-willed, over-excited, and frequently overworked.

Inflammatory and congestive causes of painful menstruation are much in the power of women. The young girl ought to be instructed that, at the periods, she requires to be specially careful of herself, and that, if she expose herself to undue cold or over-exertion, she is likely to start morbid processes that are not of a transitory nature, but may continue for her whole menstrual life. In no department of health is the proverb—"Better keep well than mend"—more applicable than in this relation. The barbarous habit of tramping blankets at the annual cleanings in country places is frequently traced as a cause of permanent injury to young women, if they happen to be called upon to perform this service in connection with a monthly period. That, or any similar duty, ought certainly to be declined under such circumstances. Throughout menstrual life, and not merely at the first onset of the flow, a woman requires to exercise prudence at the monthly times, if she expects to retain her health in its completeness, and to avoid all influences likely to originate the miserable conditions which group themselves around painful menstruation.

In cases of painful menstruation, one of the best simple measures to adopt is to bathe the feet in hot water and mustard. Much relief may frequently be afforded by the use of a hot hip bath, or by the application of a poultice to the lower part of the belly. Hot drinks are also beneficial. In severer cases, medical advice ought to be sought.

I should like to warn mothers against accustoming their daughters to the use of spirits on these occasions. No doubt spirits and hot water relieve the pain. The remedy is, however, a very dangerous one. Every medical practitioner of experience in the diseases of women can point to cases in which women have been led to become habitual drunkards, in consequence of the free use of spirits to relieve the distress accompanying painful menstruation. A further melancholy accompaniment arises from the fact that such patients, if they live long enough, are not found to give up their bad habits when the original cause ceases, but to continue them long after the conclusion of menstrual life. Besides this, the free use of stimulants, not to say necessarily the abuse of them, is well known to predispose to diseases of a chronic inflammatory nature in important organs (the ovaries) intimately connected with the womb. This forms an additional incentive to the observance of the strictest temperance by females.

When I am on this subject, might I be pardoned for enjoining upon women the necessity of special precautions in the use of alcoholic drinks generally? The opportunities of seclusion which women possess much more than men, afford manifest temptation to the indulgence in the habit of secret drinking. That is unquestionably the worst form in which the curse of drinking can attack humanity. A woman somehow is more apt than a man, once she has disgraced herself, to plunge headlong and heedlessly into further depths of degradation. Whatever is the explanation, and I have none to offer, it is far more difficult to make a woman who has become a habitual drunkard a sober woman, than it is to reclaim a man from drunkenness to sobriety. God, who with awful emphasis has fixed His curse upon the drunkard, knows how terribly hard it is for

either man or woman to overcome this vice once it has gained the mastery. But, in my experience, there is much more hope of success with a man than with a woman. I have seen many women habitual drunkards, and I have known some of them mend their habits greatly. I am not sure if I ever saw one who fairly mastered the demon of drink.

It is to be expected that, though pain and distress may accompany the first menstrual periods, if due care is taken of the young woman for a few periods, the distress shall disappear in the future. I need hardly say that women ought not to employ strong purgatives during the periods, and that they should not use any powerful medicines. It is, however, absolutely necessary that they should be more than usually careful to attend to personal cleanliness at these times.

Now, a word or two about the Regularity of the Recurrence of the Monthly Periods.

A healthy woman ought to begin menstruation about the fourteenth or fifteenth year, and ought to menstruate every twenty-eighth day, unless she is in ill health, is pregnant, or is suckling a child, until about the forty-fifth or fiftieth year, when the recurrence of the flow ceases. That is, the normal appearance, disappearance, and frequency. But, of course, there are many exceptions.

But in this connection I want to insist upon what I consider is an important fact—viz., that women as a rule over-estimate the importance of arrest of menstruation, and thereby are led to neglect other symptoms of ill health that are of much greater value.

There is nothing in the monthly flow that can injure the woman if it does not come away. What is discharged is essentially blood, and nothing more. Its non-appearance will not poison the woman's blood as would happen if the secretion from her liver or her kidneys were arrested.

Accordingly, when a young woman, concerning whom there is no suspicion of pregnancy, ceases to menstruate, and you cannot trace the cause of it to a sudden arrest from exposure to cold or such like, the attention of those about her ought to be directed to her general

health. Is she feeble and bloodless-looking? Then she needs good food, open-air exercise, and steel in some form or other. Has she a troublesome cough or an exhausting diarrhœa, and is she losing flesh? Then serious diseases of the lungs or bowels are to be apprehended, and appropriate measures adopted to prevent their advancing. In fact, when a young woman ceases to alter, the first thought and attention ought to be directed to her general health to see that it is attended to, and the necessity of restoring the monthly flow ought to occupy only a subordinate place in the thoughts of mothers. The absence of the flow in such cases is really of a conservative nature, the blood which would be thus discharged being retained for the wants of the economy.

Excessive Flow at the menstrual periods is a symptom of various diseased conditions which ought always to lead the woman to consult a medical man, as the prolonged and repeated drain of strength through its continuance is very dangerous indeed.

Tight Lacing is a habit so frequent among women and so exceedingly injurious that I cannot refrain from referring to it. The practice arises from mistaken ideas of female beauty. The tight lacing results in ugliness. It replaces the exquisitely beautiful outlines of the female figure by the mischievous creations of the dressmaker's fancy. Nature never meant a woman to be degraded by being squeezed into the shape of an insect.

But, in addition to violating the true principles of taste and beauty of form, it leads directly to disastrous consequences in respect to the woman's health. It compresses the liver; it is not uncommon in the pathological theatre to see the liver deeply indentated by the marks of the ribs, as a result of tight lacing. It interferes with the free play of the lungs, and thus gradually deteriorates the health by defective aeration of the blood. It displaces the abdominal organs downwards, and thus leads to falling down of the womb, to rupture, and other displacements. It opposes the return of venous blood from the lower limbs and the

abdomen, and thus leads to varicose veins, to piles, and other such like evils. By obstructing the circulation it tends to interfere with the action of the heart, putting extra strain upon the central organ, and thus acts injuriously upon the circulation and nutrition generally.

The moral deducible from these facts is that there ought to be no tight lacing. If ladies must wear stays, and I for one think they would be far happier and would look much prettier without them, they surely ought to wear them loose, and to carry their skirts, not on tight bands tied around their waists, but over their shoulders.

Imperfect Clothing.—This is another cause of much bad health among women. Many women labour under the delusion that they cannot wear flannels, and they expose themselves to the inclemency of our variable and inhospitable winter climate in thin cotton dresses. Few people cannot wear flannel next their skins after a fair trial. Some ladies who cannot do so manage to wear silk next the skin and flannel over that. Every woman who has proper regard to her health ought to wear flannel all through our winter. This forms the best protection against cold. Remember colds are not to be trifled with. We never know how a cold may end and what forms of disease it may give rise to. Time was when we thought that to establish consumption we needed an inherent tendency in the individual. With a better knowledge of the true nature of this disease we know that from an ill-cared-for cold in the chest the strongest and healthiest may quickly fall a victim to consumption.

Then again, rheumatic fever is very common among the young of all classes, but particularly so among hard-working servant girls. This leads every year to untold misery. Rheumatic fever, much more than any other fever, is apt to leave disastrous traces of its action in the constitution. It acts specially upon the heart, and is the commonest cause of heart disease. The fever seldom kills directly, but it acts injuriously by weakening and perturbing the central organ of the circulation. In consequence of this the victim's health is permanently shattered, the seeds of much misery sown,

and, in almost all cases, the period of life abbreviated. Surely, to avoid such a catastrophe some care ought to be given to make sure that our women are warmly clad and able to resist the severity of our climate.

All classes of society in different ways are victims of this mania for light clothing. Ladies in the higher ranks suffer by wearing low-bodied evening dresses, in which they drive home from places of entertainment in the cold winter nights in draughty cabs or carriages after being overheated, and perhaps also exhausted, in the ball-room. Domestic servants get overheated and tired out in the kitchen and laundry, and, on leaving these, are exposed to cold through neglect to dress warmly. Sometimes I fear the anxiety of wearing showy dress leads to selecting clothing for the sake of appearance and not of comfort. If a shop-girl or a servant cannot afford to have her dress both showy and comfortable, she ought always to choose the latter. I ought to mention also here that imprudent exposure to cold may readily induce disease of the kidneys, of the womb, of the bowels, and indeed of various organs.

It would lead me too far to refer to particular employments that are specially trying for women. It is gratifying to notice the efforts that have lately been made to induce shopkeepers to provide seats for their girls when they happen to be disengaged. I hope this will become general, as the continuous hanging on their feet of the girls from "morn till noon," and from "noon till dewy eve," is very exhausting, and is surely unnecessary.

The use of the foot sewing-machine is fraught with troubles to women. A foot-sewing-machine should, therefore, not be undertaken by any woman who has any tendency to womb disease.

Girls who are compelled to lead sedentary lives in earning their living ought to take every opportunity they can to obtain the needed out-of-door exercise in their spare time.

HABITUAL CONSTIPATION is a common failing with women. It is apt to land them in great trouble. It doubtless predisposes greatly to, as well as aggravates many diseases of the womb and parts adjoin-

ing of a congestive or inflammatory nature. It becomes a matter of the greatest importance to avoid this habit. As far as possible, this ought to be done without the use of purgatives. Regular exercise is one of the best measures to help in overcoming the tendency. The systematic use of a cold bath each morning is another useful adjunct. The use of fruit or preserves at breakfast is also valuable. Porridge, eaten with treacle instead of milk at breakfast, sometimes succeeds.

In some cases a glass of cold water, drunk either the last thing at night or the first thing in the morning, will succeed. At times a cold water compress, bound over the bowels at night, may effect the result wished for.

Whole wheat boiled until it is thoroughly softened, and then eaten as a pudding, sometimes succeeds, as pointed out lately in the *British Medical Journal* by Dr. Rabagliati, of Bradford.

Women ought to remember that much good results from regularity in attending to the requirements of nature. If all these measures fail, an occasional enema of cold water may be used, or it may be necessary to employ occasionally an aloetic laxative, such as Hamilton's or Christison's pills. It is better not to employ salines, such as Epsom salts, as they constipate after they have exerted their first action.

The sedentary habits of women are not always a necessity; often they are the result of choice. That should not be. With active habits these drawbacks to comfort very frequently disappear.

Many things more could be added to the regulation of the young woman's health and habits; but the time allotted will not permit me.

3. I now pass on to direct attention to some things that specially concern Married Women and Mothers.

Suppose a young woman is married, and has become pregnant, certain general principles ought to regulate her conduct during its currency. In the first place, however, I would take leave to say that the pregnant woman ought to live very much according to her

usual manner of living, but ought to guard against certain awkward contingencies.

First among these may be placed the risk of abortion or miscarriage, which occur in one out of every tenth pregnancy. Abortion is most likely to happen before the end of the fourth month. But pregnancy may be abnormally terminated at any period, and in the latter two months there is again increased risk of premature delivery.

The causes of abortion are very various, and many of them are entirely beyond the control of the woman. But certain of them she should be able to guard against. Among the latter we may mention the risks from lifting very heavy weights; from recklessness in stepping from a carriage or train on to the road or platform; leaping from heights; or anything which subjects her body to sudden jerks or succussions.

But what I would more particularly urge in this connection is the necessity for women who have aborted to take proper care of themselves until they have completely recovered from the accident. Very great misery results from ill-cured abortions. You have all heard that it is better to have a broken leg than a bad sprain. Now, no person means that a sprain in itself is so serious as a broken leg. But the real explanation of the proverb is, that if you have a broken leg, it compels you to take the necessary measures for your recovery; but if you have a sprain, you go on using the limb till chronic mischief is established in it.

Now, more danger results to women from abortion in proportion to their numbers than from confinements. The reason is that women treat the illness too lightly; they do not lie up; they frequently do not apply for medical advice even till they are compelled by some of the bad symptoms that follow their neglect.

In case of an abortion, however early, a woman ought to look upon it as a confinement. She ought to lay up—it need not be so long—as after a delivery at full time. Still she ought to keep her bed a full week after an abortion. It is important that measures be taken to make sure that the whole of the abortion comes away.

The discharges therefore ought always to be retained and shown to the doctor.

The chief dangers from abortion are bleeding and fever at the time—exhausting bleeding afterwards, if the abortion does not come completely away; and sometimes permanent enlargement of the womb, with excessive flow at the periods, and whites between the periods. As these evils are usually preventable by due rest and care, you will see how important it is to give that care, and take the necessary rest.

Morning Sickness, with vomiting, is an affection that is apt to torment the pregnant woman greatly. It usually comes on at the end of the first month, and continues till mid-time. It is sometimes so severe as to be fatal; at other times it is entirely absent. The measures in your own power to limit its evil effects are—attention to take such food as is light, such as white fish, fowl, tripe, rabbit, beef-tea, chicken-tea, toast without butter. The food should also be taken frequently, in small quantities at a time, so as not to distend the stomach, as this greatly predisposes to vomiting, and at such periods as the patient has noticed the vomiting to be least annoying. If the patient vomits in the morning, and at no other time, food should be delayed till afternoon and evening. If the patient vomits during day, and never at night, food should be taken at night only, and so forth. For medicinal treatment and in serious cases, a medical adviser ought to be consulted.

Bleeding in Latter Months of Pregnancy.—In the latter months of pregnancy bleeding of a serious nature is apt to come on. Under such circumstances, a patient is bound to acquaint her medical adviser, so that proper steps may be adopted for its arrest.

Constipation.—Women during pregnancy are apt to suffer from troublesome constipation. It is dangerous for them to use strong medicines at this period. Among suitable laxatives may be named castor oil, compound liquorice powder, or Christison's pills, &c.

Patients may also expect piles and varicose veins of the legs during pregnancy. They are not to be alarmed regarding them. They usually pass off after delivery.

Confinement and Lying-in Period.—At her delivery every woman needs medical care and nursing. She cannot then do without assistance in some form or other, so that I need not remark upon this subject further. But I must be forgiven if I make some observations upon the time of getting up, as it is a matter in which the women of the working classes are particularly tempted to err, and in which they do go wrong.

Our well-to-do ladies may safely be left to their doctors and nurses.

But the wives of our working men are most unfortunately placed. Their scanty means preclude them from easily procuring the necessary nursing, and as they frequently feel pretty well they come to think that they should at once be up and attending to their household duties.

But I want them to put the matter before themselves in this way :—

Whether is it better to rest a little longer at a lying-in period, even although great inconvenience should result therefrom, provided the mother is certain to rise from her bed healthy, vigorous, and able to be useful to her husband and family, or to get up too early with a certainty of becoming more or less of an invalid for life? How is it that the women of our working classes age so rapidly compared with those in the better classes, and even compared with their husbands? That they do so is unquestionable; for you frequently see a working man's wife at thirty look like a woman of fifty. We obstetricians know that the great majority of such patients suffer from the evil effects of getting up too soon after their confinement.

It is not the direct results of the labours, but the indirect results of them. Getting up too soon induces enlargement of the womb, with excessive flow at the monthly periods, and exhausting white

discharge between times; whilst, along with these dragging feelings, down-bearing pains, back-ache, and other miseries render the woman's life a burden, and greatly mar her usefulness.

Now, no doubt, poor women are often compelled to rise too soon after a confinement, from having no one else to attend to their duties. But I am satisfied many others frequently err through ignorance, being unaware of the necessity of rest and quiet for a lengthened period. As far as regards the first class I can say nothing. We all in our turn must yield to the inevitable. But to those who ignorantly or thoughtlessly expose themselves to these risks I want to say, with all the earnestness I can summon, Consider the consequences. Don't heed the common delusion that a patient ought to be able to get up on the ninth day.

On our better class patients we insist that they should remain strictly in bed a fortnight, move from bed to sofa for another week, and get from the bed-room to the drawing-room the fourth week. After that we let them out for a drive. These are by no means too great precautions.

Remember that after delivery a woman's difficulties are in a great measure only beginning. The womb and connected organs need time and rest to return to their original state. The natural changes are very apt to be interrupted by any careless exposure or exertion.

It takes from six weeks to eight weeks for the womb, &c., to return to the normal condition after labour, consequently a patient can never remain in bed too long.

Food when Nursing.—The best adjunct to a patient's food when nursing is milk. It is a mistake to think that porter or other alcoholic drinks are needed. I have seen much harm done by their use when taken in this way. Women, when nursing, should avoid food that disagrees with their stomachs and induces indigestion, but otherwise no fixed rule is to be observed in regard to the nurse. In my opinion women trouble themselves far too much on this point.

Over-lactation, or Nursing too Long.—This is a common and

disastrous custom. It often permanently unhinges a woman's health. The child should be weaned by the end of the ninth month at most. It is a mistake to think that nursing necessarily prevents a woman from again conceiving. If she does fall pregnant while nursing, the double strain on her system is apt to be specially injurious. The usual symptoms of over-lactation are liability to headaches or flitting neuralgic pains over the body, giddiness, palpitation on slight exertion, attacks of blindness, with noises in the ears, and a tendency to get faint. Such feelings are evidence that the woman is suffering from nursing too long, and that she ought to stop giving suck—this is, of course, quite independent of the actual period the mother has given milk.

How to know whether a Mother proves a suitable Nurse.—The question as to whether a mother is fit to nurse, or gives good milk, depends upon the effect of nursing upon the child. If the child does not thrive upon its mother's milk, gets ill, takes diarrhœa and wastes away, then, in the interest of the child, nursing should be given up, as, in that case, the mother's milk is clearly deficient. But such cases are very uncommon.

Question of Nursing when Menstruation comes on. — This matter puzzles mothers greatly. Is a mother to cease nursing when she sees the monthly periods return? My advice is to watch the effect on the baby and on the mother. If the child thrives, and is not made sick by the mother's milk when the monthly flow is on her, then, so far as the child is concerned, matters may be left alone. The problem then is to be solved in relation to the mother only. If the monthly flow returns only once or twice, then the mother may go on nursing; but if it continues regularly to recur, then she ought to wean the child, if the symptoms of too prolonged lactation already referred to manifest themselves, but if her health keeps perfectly good she may be allowed to nurse till the child is eight or nine months old.

How to Manage in Putting away Milk.—The best plan is

to put the woman on a very dry diet, allowing only a small amount of fluids of any kind, and to put on belladonna plasters on the breasts. I wish you particularly to avoid the injurious practice, so frequently adopted, of taking strong purges at this time. That kind of treatment very unnecessarily weakens the patient and does no good.

One point now, and I have done.

Change of Life comes to most women from the forty-fifth to the fiftieth year. In some cases the flow stops suddenly—in most cases it becomes irregular in amount and recurrence for a year or more. About this time women must expect to experience certain somewhat distressing sensations. Among the most common of these is a frequent liability to attacks of heat, followed by profuse perspiration and ending in a feeling of chilliness. There is often also a sense of fulness in the head, palpitation, and general discomfort. Patients ought to bear these facts in mind to save them from unnecessary alarm. Women should also know, that about this time important diseases are apt to become developed, and ought to take prompt measures to obtain medical advice when any unusual symptoms annoy them, in case they may by delaying too long, allow themselves to get beyond the reach of human help.

APPENDIX.

"*HINTS TO WOMEN REGARDING THEIR HEALTH, HABITS, OCCUPATIONS," ETC.*

1. THE YOUNG GIRL.—2. THE YOUNG WOMEN.—3. THE MOTHER.

The Young Girl.—It is of the first importance to form regular and proper habits, framed according to the laws of health.

From birth upwards, the female possesses special instincts and peculiarities that necessitates corresponding attention from those who wish to bring a girl up to be a healthy and useful woman or mother.

Much of the misery and many of the deaths of married females, depend upon deformities of the bony plevis, or want of symmetry in it. These deformities are in a great measure preventable if due care is bestowed upon the nutrition and management of very young girls, especially upon the avoidance of rickets, or the proper management of that disease.

It is of importance also that young girls should not be burdened with too heavy loads or too great toil, till their bones are properly hardened and matured.

Out-of-door exercise, plenty of romping, running, calisthenics, and so forth, ought to be much more inculcated upon young girls than is usual, in order that their organs, such as the heart and lungs, shall be well developed, and their muscular system strengthened.

As the emotional and imaginative nature of girls is particularly sensitive, great care should be taken in the education of girls not to over-stimulate those qualities of their minds, in case we have morbid reactions, commonly grouped under the name of hysteria, developed.

The Young Woman, as she passes from girlhood to womanhood, ought always to command the careful attention of her female friends. She ought to be apprised by them of the approaching monthly flow before it appears, to avoid unnecessary alarm and distress on the girl's part.

The monthly flow, when everything is right, ought to be without distress or pain.

Pain of a certain amount is very common : and in many cases there are pain and distress throughout life connected with the periods, rendering the woman's whole menstrual life miserable.

As this is much more apt to occur if the first two or three periods are neglected in the girl, it is necessary that these be carefully attended to.

The causes of all others most apt to induce painful menstruation are—

1. Weak health, with a nervous temperament.
2. Congestive or inflammatory affections of the womb, or parts adjoining it.

We must endeavour to overcome the former causes by careful attention to the physical and moral training of the girl, so that when the crisis comes she may meet it with, as far as possible, a sound mind in a sound body.

Inflammatory and congestive conditions are much in a woman's own power. They are developed through want of care or over-exertion, or exposure at or near the periods ; and every girl ought to be instructed to avoid inducing them, by practising the necessary care at and near the periods, particularly during the first few periods.

Women need to take unusual care of themselves at these times throughout their menstrual life.

In case of painful menstruation, the best simple treatment is to put the feet in hot water and mustard for a time—or to use a hot hip bath—apply poultices over lower part of the belly—and to take hot drinks.

In very severe cases a doctor ought to be consulted.

Stimulants should never be taken to allay the pain of a period without medical advice, as their use is exceedingly apt to lead to the habit of drinking.

Women ought to be exceedingly careful of falling into this vice, as the opportunities of seclusion they possess form a temptation greater than men usually have for indulging in secret drinking.

It is also more difficult—whatever be the explanation of it—for a woman to return to the path of sobriety, once she has left it, than for a man.

Strong medicines ought to be avoided during the periods. Personal cleanliness is specially required then.

Stoppage of the Flow.—Women are apt to over-estimate the importance of this occurrence, and to pay attention to the arrest of the flow, to the neglect of more important matters. The mere stoppage of the monthly flow itself can do no harm—it is merely a little blood.

If the woman has not been exposed to cold, so as to cause inflammation or congestion of the parts, and if she is not pregnant, then the stoppage of the flow ought always to direct the attention of the friends to her general health.

The arrest may be from poverty of blood, when the girl needs iron and cod-

liver oil. It may be from threatening consumption of the lungs, when it will be accompanied by a dry cough, and the girl needs good food, good air, and cod-liver oil. It may be from some other disease of important organs, such as the kidneys and the bowels, and should always lead the patient to consult a doctor. Any severe acute disease, such as a fever or an inflammation of the chest, is apt to stop the flow for a time or two.

Excessive flow at the periods arises from various diseased conditions, and ought to lead the sufferer to consult her medical adviser, as it is very weakening.

Tight Lacing is an exceeding pernicious habit among young women. It replaces the beautiful outlines of the female figure by artificial distortions, and therefore produces ugliness. It interferes with the action of the chest, compresses the liver, and displaces it: interferes with the action of the heart, and displaces it; it tends to induce displacement of the womb, and other contents of the abdomen; to cause rupture, piles, varicose veins of the lower limbs; and, putting extra work upon the heart and lungs, leads to imperfect nutrition and development.

It is false in taste, false in physiology, and mischievous in its results.

It ought never to be practised.

Wearing too Thin Clothing.—This is a cause of great injury to young women. Many will not be induced to wear sufficient clothing from false ideas as to beauty. Others cannot afford both good substantial clothing and showy dress, and prefer the latter, though it injures their health.

In our climate, in the winter months, every woman ought to wear flannel next her skin. In this way the evil effects of cold in the chest, of rheumatic fever, inflammatory conditions of the kidneys, womb, etc., are best avoided. Women are often guilty of bringing on themselves consumption of the lungs or rheumatic fever, and, through its means, hopeless disease of the heart, by want of care in putting on warm clothing when they are exposed to cold.

The use of a sewing machine driven by the foot, should be avoided by women having any tendency to disease of the womb.

Girls who, in earning their livelihood, are compelled to spend a great part of their time sitting, should take every opportunity to overcome the evil effects of this by open-air exercise.

Habitual Constipation is particularly apt to distress women, and tends to induce womb disease.

As far as possible it should be mastered without the use of purgatives. Among the means that may be useful, regular exercise—systematic use of a cold bath each morning—fruit at breakfast—porridge eaten with treacle—a

glass of cold water at night or in the morning—whole wheat boiled to a pulp and eaten as a pudding—also occasionally an enema of cold water. Regularity in attending to the calls of nature is also of importance. If all these measures fail, then some mild laxative should be employed. The compounds of aloes, such as Hamilton's or Christison's pills, are the best, as they do not constipate afterwards. Salines, such as Epsom salts, should be avoided, as they constipate after they have acted.

THE MARRIED WOMAN AND THE MOTHER.—*Pregnancy*—A woman during pregnancy should live as usual, only she should take special care of her movements, particularly till after the end of the fourth month, and again in the last two months, in case she induce abortion or miscarriage.

Abortion takes place in about one in ten of all pregnancies.

Many causes of abortion are beyond a woman's control.

But some of them, such as lifting heavy weights, jumping from a height, jerks and jolts of the body, over-exertion, and so forth, she may avoid.

Women ought to know that ill-treated abortions often lead to the entire ruin of health, and ought to regard an abortion as a delivery, keeping their beds for at least a week after it.

They should retain what comes away to show it to a doctor, as it is important that the whole abortion should be removed, in case if part be retained it may lead to future complications.

The dangers that flow from ill-cured abortions are—much bleeding for long periods afterwards—permanent enlargement of the womb—excessive flow at periods, whites between them, and chronic ill health.

These are avoided by care at the time.

Constipation is apt to be troublesome during pregnancy, but should only be treated by very mild measures.

Lying-in Period.—Patients are apt to get up too early, especially the wives of our working men.

In this practice very many evils originate. It is much better, at whatever inconvenience, to take the proper rest and quiet after delivery, than to bring on ill health and impaired usefulness for life.

It is chiefly on account of the evils resulting from getting up too early after confinement, that the women of our working classes age so rapidly, compared with those in better circumstances.

It takes six to eight weeks for the womb and parts connected to return to their normal condition after delivery.

Consequently, special care is needed during this entire period.

Too long rest cannot be taken after delivery.

The chief evils that result from neglect after con nement are chronic enlargement of the womb—excessive flow at periods—whites between periods, dragging feelings in the loins, back-ache, displacement of the womb, and general ill health.

Nursing.—The best element in a woman's food who is nursing is cow's milk ; that is much better than porter or wine.

Nursing too Long is very exhausting on women. It should not be practised. Nine months are quite long enough to nurse.

Giddiness, tendency to faint, neuralgic pains through the body, headache, palpitation, and general feeling of illness, are the chief symptoms of nursing too long, and should make a woman wean her child.

Nursing in relation to Menstruation.—If a woman menstruates once or even twice during nursing, and the baby is not thereby made ill, there is no use stopping the suckling. If menstruation continues throughout the nursing, and the child is found to thrive, then the woman should stop nursing only if her own health is found to threaten to give way, in the manner above described in connection with nursing too long. But if her health keeps good and the child thrives, she may go on nursing till the end of nine months.

Weaning.—At weaning do not use purgatives, they are injurious. Take food specially dry, and put on a couple of belladonna plasters on the breasts.

Change of Life is apt to be associated with certain disagreeable feelings, particularly those of heat and cold, also with irregularity of menstruation for lengthened periods. These a woman is to expect, and not take alarm from. Women should know that important diseases are apt to arise at this period of life, and ought not to unduly postpone applying for medical advice if any untoward symptom supervenes.

ON THE REARING AND TRAINING OF THE INFANT AND CHILD.

By Dr C. E. UNDERHILL.

On the Evening of Saturday, 15th January, Dr Underhill delivered the seventh of the Course of Health Lectures in the Free Assembly Hall, his subject being "On the Rearing and Training of the Infant and Child." Dr Underhill said :—

Ladies and Gentlemen,—

You, all of you, or at least most of you, read your newspapers. You may have noticed every Monday, down in an obscure corner of your paper, a list containing some names and figures, and called "Health of the City." In it are recorded the numbers of births and deaths which have taken place during the past week, and some of the causes of the deaths. Besides this, there are mentioned the numbers who die at different periods of life. And this is the point to which I wish to draw your attention; for, if you take a number of weeks running, you will find that nearly half of those who die are children under five years of age. Thus, in the month of September last, forty-five out of every hundred who died were children under five years of age; in October, forty-two out of every hundred; and in November, thirty-seven out of every hundred: on an average, nearly forty out of every hundred.

Just think of that, not much less than half of these sad records are made up of the lives and deaths of little children who cannot

help themselves; when they grow older, and can take care of themselves, the numbers are very different, but as long as they have to be left to the care of others, their chances of living are much smaller. And so it is in large towns all over Scotland—and all over Europe, too, for the matter of that—week after week, month after month, you may read the same painful story.

Now let us stop one moment and see what this means. It means that hundreds upon hundreds of children who are born into the world for the most part strong and healthy, are allowed to droop and die before they have got over the helpless period of childhood; it means, only too often, want of care, want of knowledge, and want of means on the part of their parents. For the loss of very many of these little ones is due to preventible causes.

Some of them die from diseases of the stomach and bowels, many a time brought on by improper food; others from those of the chest, which are frequently due to neglected colds, scanty clothing, and careless exposure to extremes of weather; and many more fall victims to the long list of fevers, and other catching diseases, which might be rendered much less frequent if we all tried our best to prevent them from spreading; by isolating the sick as soon as possible, and by trying to prevent your own children from catching them *from* others who are infected, or from spreading the diseases *to* others, if your own have any of them, in the manner which will be explained in one of the later lectures. I need only say here that these fevers are commonly spread by allowing healthy children to run about and visit or play with those who are sick, or just recovering from them: they might as well be allowed to play with fire. Another most dangerous practice, and one which is only too common, is allowing those who are convalescent to mix with the healthy before they are thoroughly recovered; they carry the diseases with them, and thus sow them broadcast. They are thus a serious cause of danger to the community; and they are also, as I shall show further on, exposing themselves at the same time to a terrible risk.

My object to-night is to try to tell you how to feed, and clothe, and care for your children, so that you may bring them up healthy, strong, and useful; and to give you some advice as to how you may avoid some of the evils and dangers which help to cause the dreadful mortality I have just described.

First of all, then, there are some hints which may serve for children of all ages; and though I dare say you know all about them already, you must bear with me if I mention things which everybody knows about, but which everybody does not put in practice. More mistakes are committed, I verily believe, and more lives lost, from want of care than from want of knowledge. One of the most important things to attend to is *warmth.* Children, and especially very young chidren, are extremely sensitive to cold; they feel the changes of the air, from warm to cold, and from cold to warm, much more severely than older persons do; the cold frosts of winter and the east winds of spring are very apt to bring on colds and coughs which may end in serious disease; and, on the other hand, very great heat is equally bad for them, and also may make them ill, though in a different way; diarrhœa and convulsions always increase in frequency as the weather gets hotter—it is therefore very important to attend to the proper dress and clothing of your children. Now I must beg you to get rid at once of the great mistake of thinking that children have great power of resisting cold, and that they are strengthened and hardened by exposure to it. There is no more serious error, there is none attended with more fatal results; and this belief is unfortunately a very common one · you cannot be too often or too strongly warned against it. The clothing of a child should be enough to keep it warm at all seasons, it should have more and warmer garments in the winter than in summer, and the winter clothing should be put on early in the autumn and continued until late in the spring. And remember, the most trying and dangerous days are those in which the wind is high, particularly when it blows from the north and east. The best material for the inner garments is flannel,

and they should be made so as to cover the upper part of the chest and neck, so as not to leave these most delicate parts exposed to cold blasts. A neglect of this is a very frequent source of bronchitis and croup, and may serve to sow the seeds of consumption. If there is any tendency to diarrhœa, a flannel binder should be worn round the bowels. But the clothes must not be made too tight, they should fit loosely and easily, and not put any restraint upon the free movement of the limbs and body. Full room must be allowed for growth, which is constantly and rapidly going on; they should be made so as to be put on and off easily, particularly for the young babies and infants who get cross and irritated if the process of dressing them takes too long. Avoid altogether the use of pins—a needle and thread or a button does much better. Many a time have I seen a child in a violent fit of crying, for which no cause could be given until on coming to undress them, a carelessly placed pin has been found scratching the skin and causing pain. In cold weather, long drawers and stockings keep the skin well protected, but the latter should never be fastened with garters, which bind the skin too tight and always do harm. This remark applies, by the way, quite as much to grown-up persons also. Garters are an unmitigated evil. While not tight enough to impede the flow of blood into the leg and foot, they are sufficiently tight to interrupt its free flow back again through the veins; and thus they tend to produce swollen feet, and the swollen and varicose veins which are so common in women. To the eye of a medical man they are simply a relic of barbarism. Change the clothes every day and keep them as clean as possible. Whenever any of the garments is wet or dirty change it. Wet and dirty clothes are a constant source of skin diseases.

Another fruitful source of disease is *dirt*. Dirt in your houses and dirt on your children. Dirt has been called "matter in the wrong place:" it is very much in the wrong place when it is on the skin of a child. Therefore keep your children clean, and keep their clothes clean and tidy. They look much better and are much

healthier for it. Of course when they are old enough to run about they will soon make themselves dirty again, but soap and water are cheap, and the little extra trouble is well repaid in the health and comfort of all. Never put a child to bed dirty. Don't be satisfied as too many are with washing their hands and faces; the whole body should be washed every day. Young babies and infants should be bathed and well washed every morning in warm water, and thoroughly well dried afterwards. As they grow older, the water need not be so warm, but it should not be quite cold during the cold weather. In summer cold water is best. The bathing should not be done too soon after a meal, never within an hour. This caution is specially needed by boys; who are apt, in the summer, to run off, as soon as they have bolted down their dinner, to get a bathe or perhaps a lesson in swimming in the nearest available water. Bathing too soon after meals is a serious mistake; it is almost sure to disorder digestion, and may cause cramps and other serious mischief. Young infants are best washed after their first meal, older children before breakfast. How important a clean skin is we see when we think of the vast amount of insensible exhalation of gases, and perspiration of fluids which goes on night and day through its pores; if not washed away, this perspiration dries and remains on the skin, chokes up the pores and sets up an irritation which frequently ends in some positive skin disease. We are too apt to forget that the skin is one of the three organs by which the effete products of decomposition are carried off from the blood. The kidneys and the lungs being the other two. The little pores with which we are all familiar are the mouths of minute sweat glands, of which it is calculated that there are about two thousand eight hundred, on an average, on every square inch of skin all over the body. When these are partially closed by dirt or disease, more work is thrown upon the other organs, and this leads to a derangement of the general health; if they were totally closed, by varnishing or painting the body all over, the child would very shortly die—it would die as surely, though

not quite as quickly, as if a cord were tied round its neck and all breathing put an end to. Be sure and dry the skin quickly and thoroughly, rub it briskly, and don't leave off until it is perfectly dry; a half dried skin is sure to be made rough and sore very soon by the wind. Besides, the daily morning wash is a stimulant and tonic to the whole system which helps to make it vigorous and healthy. It is particularly necessary to attend to the cleanliness and dryness of the napkins which are used to a baby, the discharges which come from the bowels and bladder of a baby are very irritating, and if a wet and dirty napkin is allowed to remain applied to the skin it soon makes it sore, the skin gets red and inflamed and peels off, and these sores take a long time and much care to heal. They are easily prevented by proper care; it is the old story of a "stitch in time" saving a good deal of sewing afterwards.

If possible of even more importance than cleanliness *are fresh air and exercise.* If there is one thing more certain to produce disease and prevent the healthy growth of a child than another, it is breathing impure air. We all live and are able to grow by taking air into our lungs and food into our stomachs—but we only need food every two, three, or four hours, or even seldomer, while we have to take in air fifteen or twenty times a minute all our lives—if this process is stopped for a minute or two we die. Now you all know how much discomfort and disease is produced by one unwholesome meal, and just think what must be the result of a constant or prolonged breathing of unwholesome air—and by unwholesome air I mean mainly air which has been breathed before and has thus become foul and unfit for use—and the worst of it is, that breathing impure air does not produce such immediate ill effects as taking an unwholesome meal, and so we are apt to overlook it; but none the less does it, little by little, undermine the health and sow the seeds of disease. The commonest cause of consumption and scrofula is foul air. A great doctor, the late Sir James Clark, has said only too truly, "If an infant, born in perfect health and of the healthiest parents,

be kept in close rooms, in which ventilation and cleanliness are neglected, a few months will often suffice to produce consumptive disease," that is to say to throw it into a decline. You can see when a child has had an unwholesome meal, because it has pain and vomits, or has diarrhœa and is feverish; it tells its own tale at once; and you can see, though less quickly and easily, when a child breathes unwholesome air, because it grows up pale, and thin, and puny, it loses appetite, suffers more than ever from cold, sits by the fire and takes no interest in its work or play, and soon developes a cough which is often the earliest sign of serious disease.

To escape from these evils, children should be out in the air as much as possible; babies should be carried out every day when the weather is fine—this may be done in winter if the child is warmly wrapped up and protected from the wind—but, at the same time, the mother who carries out her child must not stand about gossiping at the corner of the street, and forgetting that all the while the keen wind is exposing the child to risk; in this matter common sense and carefulness are the best guides. Open the windows freely while the children are out of the room. The sleeping-room is the one most needing ventilation; try and realise and keep in mind that foul air is poison to young and old alike—it may be a slow poison, but it is a very sure one. Older children ought to be in the air all day long in the summer, and whenever it is fine in the cold weather. Take especial advantage of *sunny* days. Children require sunlight as much as fresh air to make them grow healthy and strong. Have you ever tried to rear a plant in the dark? If you have, you know that the stems grow long and thin, and weak and white, and never gain their proper colour—and so it is with children. If your rooms and houses are dark and out of easy reach of the *sun*, it is all the more reason for letting your little ones be out when there is light and air in plenty. A healthy child will play about and keep itself warm. One word of warning, however—colds are often caught by letting them lie or sit down on the ground or the grass when

it is cold and wet, or stand about in a wind when they are perspiring; in this way, what should be a blessing may turn out a curse.

One word as regards exercise—don't be in too big a hurry to teach a child to walk; lay it on its back and let it kick about as much as it likes while it is very young. A little later it may crawl and creep about in perfect safety, but when a child is made to stand before its legs are strong enough to bear it, they are very likely to give way and become bent—the body is too heavy for the weak bones of the legs and they become deformed. I see scores of such at the Children's Hospital; the more they stand and walk the worse they become; and the only way to prevent this from happening, and to cure it when it has happened—for it generally can be cured with care—is not to let them be on their feet until they are stronger.

Another thing quite essential to the health and growth of a child is *sleep*—and there are some points about this worth attending to. Children require much more sleep than grown up persons. They require to be kept very warm when sleeping; the natural warmth of the body is less during sleep than at other times; the hours of sleeping should be made quite regular: this is easy to manage if you begin with a baby at once; they soon acquire regular habits, and in the matter of sleep and feeding, this regularity of habit cannot be begun too soon: a bad habit is difficult to break.

For the first few weeks a baby should sleep almost constantly, only awaking at regular intervals to be fed. After the first two months it lies awake longer, and is fed less often—it should then be put to sleep for at least two hours in the forenoon, from ten till twelve or thereabouts, and again in the afternoon for at least an hour. But too much sleep during the day at and after this time spoils the rest at night, which is the most important time for rest. For the first month a child is better to sleep with its mother, after this it may be put into a crib, but never cover its face with a handkerchief, and never have curtains to your crib—they cause the child to breathe its own air over again and always

do harm. The crib must be put in a warm place, out of the draught, and there should be plenty of warm bedclothing. But observe this—when you see a young child constantly kicking off the bed-clothes at night, and especially if it be found freely perspiring about the head, watch it carefully—there is sure to be something wrong with it: these are among the earliest signs of the serious disease called rickets. Take care to keep the bed-clothes clean, sweet, and dry. Older children should be allowed to sleep an hour before dinner up to the fourth or fifth year, when it may be discontinued. Put them to bed at night early—between six and seven o'clock, and they will generally sleep twelve or fourteen hours. Never wake a child suddenly—the change from sleeping to waking should be gradual. When a child awakes in the morning it should not be permitted to lie long in bed; take it up and dress it, and so you may get it into the regular, healthy, and most valuable habit of early rising.

After the child is up don't immediately make up the bed again, as is too often done, but let the mattress be shaken well up, and have the sheets and blankets thrown over the back of a chair or off the bed, and exposed to the air for an hour or two, that they be thoroughly dried and ventilated. Open the window freely.

We now come to the question of *food*—the most important of all. How is a child to be fed? More harm is done, and more lives are lost from improper feeding of the young than in any other way. And this is the case, in spite of the fact that nature has supplied, ready to hand, and in plentiful quantity, the best of all foods, the milk in the mother's breast: and as this is the natural food, so it should be the model which we are to imitate, if it be necessary from any cause, to give the children some other food in its place. Every mother should make it her duty, as it is her privilege, to nurse her baby at the breast. The only exceptions to this rule are those cases in which, because of special delicacy or disease, they are forbidden by the doctor to do so. Whenever, from any cause, the child cannot be brought up on the breast, the only food which should be given to it for the first

seven or eight months is milk: the milk of the cow or the goat. Milk is a compound prepared and supplied by nature, and contains all the ingredients that are necessary for the growth and nourishment of the child; and no other artificial compound can take its place. A child's stomach is a very delicate organ; it has not for many months the power and vigour necessary for the digestion of other kinds of food. This is specially true of the foods which contain much starch, such as cornflour, arrowroot, sago, and others; these starchy foods are not and cannot be digested by the young infant; they simply irritate the stomach and bowels; they are, in fact, an irritant poison, that is the proper name for them, while, at the same time, the child is being starved for want of the only food it can digest. It is one thing to fill the stomach with thick farinaceous food; it is quite another thing to get it digested so as to nourish the child.

The common result of such improper feeding is that it ceases to thrive, it begins to pine, grows thinner, cries a great deal with gripes and colic; it vomits a good deal of undigested matter, the bowels become loose, and a diarrhœa is established, the stools consisting mostly of a thin, greenish, slimy, ill-smelling stuff; then to stop the crying and check the diarrhœa, soothing syrups, opiates, and other abominations are poured down its unhappy throat; artificial food and drugging go hand in hand, while the only means of stopping the disease and restoring the child to health—viz.: by withdrawing the cause of all the mischief—the indigestible food—is neglected.

It is sad to think of the loss of life which this most pernicious error causes. A recent writer* has put it thus: "The slaughter of the innocents in the days of Herod claims the attention of the historical student, and creates a feeling of horror at such barbarities; but the Herodian murder of infants is nothing compared with the thousands which are sacrificed on the altars of ignorance and fashion. The history of their slow sufferings and death is not written with the point of the sword in characters of blood;

* Dr Benson Baker, in his excellent little book, "How to Feed an Infant."

they pass away silently, like snow as it thaws, and thus fail to attract general attention."

Now, the point I wish to impress upon you is this, that the only food suitable for a young baby is milk. It may be given in two ways, either from the breast of the mother, or from the bottle. The breast milk is infinitely to be preferred; but if she have not enough milk, or if her calling compels her to be away from her child during the day, it ought to have the breast at night. It is better to suckle the child at night than not at all. Let it have as much breast milk as possible, and only make up the deficiencies with the bottle. It is quite a mistake to suppose that mixing the two milks does any harm. The breast milk may be compared to gold, the cows' milk to silver; all farinaceous and artificial foods are base money. No man would be foolish enough to say, "If I can't have all gold, I won't have any; I don't like mixing the coins." Take all the gold you can get, and add the silver to make up the necessary amount.

First, then, as regards nursing at the breast. The child should be put to the breast early, within the first twelve hours. The first milk which comes is different from what comes afterwards, and helps by gently acting on the bowels to prepare the passages to properly digest the fully formed milk. Instead of doing this, nurses are far too apt to administer a dose of castor oil. It is very hard for an unconscious infant to begin life with a nauseous draught like that; and in ninety-nine cases out of a hundred, it is quite unnecessary and wrong. If the milk has not yet come, the act of sucking will help it; and if the child cries with hunger, a little weak milk and water may be given with a spoon. The milk, however, soon appears, and as soon as this is fully established, the child should be put to the breast *regularly* at stated intervals—every two hours during the day, and less often at night. By this regularity you gain two objects. You allow time for the one meal to be digested, and for the breast to fill again before another meal is required; and you begin the training of the child by teaching it regular habits. By carrying out this system

thoroughly, you may make moral training go along with physical growth, and you render both mother and child healthier and happier.

The mother while nursing should take good food in sufficient quantity; but she should not be drinking all sorts of foods at all sorts of hours, under the idea that she will thus make more milk. She is more likely, in this way, to upset her digestion, and injure the quality of her milk. *The secret of good nursing lies in keeping in the best health possible.* Plenty of fresh air and plenty of rest, and a sufficiency of plain, unstimulating food are better milk producers than all the nostrums ever invented. It is also important to remember that any violent nervous excitement, such as anger, fright, anxiety, and grief are sure to react upon and distress the child. A sudden mental shock experienced by the mother just before nursing, or while the child is at the breast, has even been known to prove fatal to it. I would say, then, to mothers, "Cultivate a tranquil mind." It is better for you, better for your infants, and better for all about you.

The mother, if her health remains good, should continue to nurse her child for about nine months. No exact date can be fixed. If the child is thriving well, and has cut several teeth, and especially if the mother's health begin to suffer, the nursing should be at once given up. But if the mother is in vigorous health, and have plenty of milk, she may partially nurse him for a month or two longer. Beyond a year she should never go. Such prolonged nursing does harm to all concerned.

Weaning.—The child should be weaned, then, at or about the tenth month. It must be done earlier under the following circumstances. 1. If the mother's health is suffering, or if she is attacked by any acute disease. 2. If she becomes pregnant again while nursing the child. 3. If the child is insufficiently nourished upon the breast milk, and yet refuses to take other food. This happens when the milk is too thin and watery, although it may be in sufficient quantity. It thus ceases to be a nutritious food. The stomach is filled by a fluid incapable of nourishing the child

but which satisfies the appetite for the moment, and prevents his taking a meal which would be really beneficial. You must watch carefully the actual condition of the child, and not rely too much on dates, or on the advent of teeth.

It is best to wean a child *gradually*, choosing a time when he is in good health, not feverish nor fretful with the actual cutting of a tooth. It should be done by lessening the number of times he is allowed to take the breast; thus giving him time to get used to and to relish the other food given him. Reduce him by degrees to one breast meal a day; and after about a week, this too must be given up. It is not advisable to wean suddenly, unless some sudden emergency make this course necessary.

But it is not among children brought up at the breast that the great and sad mortality of which I spoke just now is found; it is among those brought up by hand, or on the bottle. And it is to a great extent due to the wrong sort of food being put into the bottle.

A word or two about bottles. The old-fashioned bottles with a cork on one side are the best. They are the best (1) because they are the simplest, (2) because they are more easily kept clean and sweet, (3) because, when they are used, the child must be held in the proper half-upright position, the natural one for a child taking food, and the child is thus kept warmer.

We should aim, above all things, at making the food we put into the bottle as like as possible to the infant's natural food, its mother's milk—and the nearest substance we can get is cow's milk. But cow's milk differs in some important ways from human milk. It is less watery, it is less sweet, and, above all, it has a much larger quantity of casein. This you can see by the accompanying table:—

CONSTITUENTS OF MILK (in 1000 Parts).

	Water.	Sugar.	Casein.	Butter.	Salts.	Total Solids.
Woman's Milk - -	889	43	39	27	2	111
Cow's Milk - - -	864	38	55	36	7	136

But the most important difference cannot be brought out by such a table; it consists in the different quality of the casein in the two milks. Casein is an albuminous compound which, when rennet or other coagulating substance is added to milk, coagulates and forms the curd you are all familiar with. Now the same thing happens as soon as the milk reaches the stomach—it curds; but the curd of the human milk is a soft, flaky substance, easily dissolved and digested. The curd of cow's milk so produced is hard and tough; it requires therefore to be given very much diluted, and we accordingly add more water to the milk than would otherwise be necessary, in order to dilute the casein more fully. So that in order to make the cow's milk as like the mother's milk as possible, we must dilute it with water and add some sugar to it. At first the proportions should be at least equal parts of milk and water, with a small quantity of sugar; if the milk be very poor, a dessertspoonful of cream may be added to each meal with benefit. And as cow's milk soon turns acid, a tablespoonful of lime-water in each bottle is often useful in making it agree better with the child. This is particularly advisable in warm weather. Two other cautions about milk:—Boil the milk intended for the child's use as soon as it comes into the house. When this is done, it does not go sour so soon; and the boiling destroys any injurious particles which may be in the milk. Where there is any doubt about the purity of the water, boil it too. After the first six weeks, the proportions should be two-thirds of milk to one third of water; and after the fourth month the milk may be given plain. *For at least the first seven months the child should have no other nourishment whatever.* But this not all. It is absolutely necessary that the bottle be kept clean. It is best to have two bottles to be used alternately, and the one of them not in use should be washed with hot water immediately after being used, and should be kept lying in clean cold water until it is wanted again. Many an attack of colic and diarrhœa is brought on by an unclean bottle. A very small quantity of milk left standing in the bottom of the bottle, or on the teat quickly turns sour, and a small speck of sour milk is

sufficient to turn the fresh milk for the next drink sour too. Smell the bottle before you put a fresh meal into it, and if there is the least sour smell about either bottle or nipple, wash it until it smells fresh and sweet. A good nose is a very useful instrument in a nursery. Cleanliness, then, is one essential to health; regularity is another. The child should be fed at regular hours—every two hours during the day, and twice during the night, for the first six weeks: after this every three hours is often enough, but then the quantity of each meal must be larger. Never give a child a bottle merely to keep it quiet; you damage its stomach and its character at the same time. Don't forget, too, that the milk which the child sucks from its mother is warm, the milk and water should therefore be warm too, and as near the heat of the body as possible, *i.e.*, at or about 98° Fahrenheit. Cold milk delays digestion, and so injures the child. The position in which the child is held while being fed is of some importance—it should be put in the same half-upright position as it is in when sucking from the breast. If allowed to lie on the back, it gets the milk too fast, and this brings on indigestion and pain.

If good cow's milk cannot be got, the condensed Swiss milk is very useful, but it must not be given too strong; half a teaspoonful to a tea-cup of water is plenty to begin with. For the first four months it is an excellent substitute for ordinary milk, and most children thrive on it: but it does not do to continue its use too long.

The next question that arises is when are you to begin and give the child any other food but milk. The answer to this depends a good deal upon how the child is thriving. If it is fat and flourishing, and has cut several of its front teeth, at the age of seven or eight months, and no earlier, a meal of some farinaceous food may be given once or twice a day. Even now the foods which contain much starch are to be carefully avoided; the child cannot yet thoroughly digest them, such as arrowroot, sago, corn-flour. The best farinaceous food to begin with is oatmeal gruel, well-boiled and strained; or, as a change, milk thickened with a rusk or well-baked flour. Chapman's entire wheat flour is an

excellent food. It is to be preferred to ordinary wheat flour as it contains the phosphates of the wheat, and also the cerealin, a peculiar ferment which changes starch into sugar. It is prepared thus: Put a pound of Chapman's wheat-flour, tied up very tightly in a pudding-cloth, into a sauce-pan of water, and let it boil constantly for ten hours. When it is cold, the soft outside layer is scraped away, and the hard interior is reduced to a fine light powder with a fine grater. A teaspoonful of this powder is rubbed up with a teaspoonful of cold milk into a smooth paste; a second spoonful of milk is added, and the rubbing is repeated until the mixture has the appearance of a perfectly smooth cream: a quarter of a pint of hot milk, or milk and water is then poured on the mixture, stirring briskly all the time, and the food is ready for use. Some of the artificial foods, which however are more expensive, are prepared in such a way that the starch is rendered soluble and easy to be digested. This is effected mainly by the addition of malt and the employment of heat. Malt, and of course barley from which it is made, contains a substance called *diastase*, which acts as a ferment, and helps digestion in the same way that some of the constituents of the saliva act on food—constituents which are not present in much quantity in the saliva and other secretions of children, until they have cut most of their teeth. The best of the artificial foods are Mellin's Extract, Nestle's Milk Food, and Savory & Moore's Food. But if oatmeal and plain wheaten flour agree with your children, stick to them. These meals should be given once, or, at most, twice a day; but ever remember that the greater part of a child's nourishment should still be milk.

I must add that we do occasionally, but rarely, meet with children with whom milk in any form disagrees. This condition is generally the result, in the first instance, of improper feeding, or of over-feeding. From these or some similar cause an irritation of the stomach and bowels has been set up, vomiting and diarrhœa make their appearance, and the child begins to lose flesh. The hard curd of cows' milk which forms immediately the milk reaches the stomach, further irritates it, and the child gets worse. Such

a case imperatively requires the aid of a doctor, and the greatest care is needed to insure recovery. Sometimes barley-water, mixed in equal quantities with the milk, will make it agree, by lessening and softening the curd; sometimes the whey of the milk, separated from the curd by rennet, and made richer by adding one part of cream, which contains no curd, to four of the whey, makes a digestible food. Occasionally it is necessary to feed them for a day or two on rice water, with the boiled rice pounded and mixed with it; but such cases are serious, and the advice of the doctor should be taken and very carefully carried out.

After the child has cut most of its front teeth—that is to say, towards the end of the first year, it may be given once a day a meal of a meat broth with barley in it, or of gravy and bread crumbs. The broth should be made by cutting up the meat finely and letting it stand for two or three hours in cold water and then boiling it. In this way much more of the nutritious juices of the meat are obtained than by simply pouring boiling water on it. At about the same time, or a little later, a lightly-boiled egg may be used instead of the broth, once or twice a week; or a well-boiled mealy potato, carefully mashed and mixed with good meat gravy. No solid meat food should be given to a child under two years of age, indeed, until it has cut all its teeth, and this for the very good reason that until its back teeth are ready for use, it is unable to chew and masticate such food so as to prepare it to be digested in the stomach. After this a little meat well-cooked may be given to a child occasionally; but it is not at all essential, and should not form a part of its every-day food. It is a great mistake to give children much animal food, particularly such as are weakly and delicate. For the first three years, it is not too much to say, the less they have the better. The best food is not that which contains the most nourishment, but that which is best suited to the state of the digestive organs at the time it is taken.

Whenever animal food is given, it should be minced very fine, and at first even bruised in a mortar, to take the place of mastication.

Bread and butter, oatmeal porridge, milk, rice, and light puddings are to form the staple of its diet. Avoid all stimulants absolutely, avoid tea, cakes, and pastry. The plainer and simpler a child's food is, the stronger and healthier will be its growth. And teach your children to eat slowly; bolting the food is a sure way to beget indigestion and stomachache. Children should only be allowed to eat at meal times, and should have nothing between them.

To sum up the advice I would give you about feeding a child.

Feed it regularly; have all food and bottles scrupulously clean; rely on milk and milk alone for the first seven or eight months—avoid starchy foods, regulate the time for adding to the food by the appearance of the teeth, and the way in which the child is thriving—and remember that the great error in rearing children is over-feeding.

There are one or two other points on which I should like to make a remark or two before I close. One of these is *teething*—and I may remind you that the number of first or milk teeth which a child gets is twenty; and that they come for the most part in a very regular order, and at pretty definite intervals. Now, the eight front teeth, four above and four below, are called "incisors;" the eye teeth, two above and two below, are called "canines" or "eye teeth;" and the eight back teeth, two above and two below on each side, are called molars or grinding teeth. The order in which they ought to come when a child is thriving and vigorous is as follows:—first the two lower middle incisors; these appear at about the seventh month, seldom earlier; they are followed in a few weeks by the two upper middle incisors; and almost immediately afterwards, the other two upper incisors, one on each side of the middle ones—a week or two later the two other incisors in the lower jaw come through, so that all the incisors generally appear before any of the other teeth; and the incisors being smaller than the others are generally cut without much trouble, and by the end of the tenth or eleventh month—after an interval of about two months the first four molars begin to appear, and

they take about two months, more or less, to make their way through the gums. After another interval of two or three months the eye teeth begin to appear, and they are fully cut by the end of the eighteenth or twentieth month—this is followed by another period of rest, after which the four back molars come, and soon after the end of the second year the first dentition is complete.

Now, a child in perfect health usually has its teeth in this regular order, and at the times I have just mentioned, and without necessarily undergoing much suffering. For teething is a natural process. Yet the period in which the teething is going on is one of more than ordinary danger to the child, but not only, and not chiefly, on account of the teeth. It is a time when growth and development are most actively going on; it is a time of change from one mode of living to another; that is to say, from a purely milk diet to one of a more solid character, and which requires chewing and a more active digestive process; it is a time when those organs and functions are getting into order, by the due action of which the body is nourished and built up.

When a child is teething, then, it requires more than ordinary care, you must watch its general condition; see that its bowels are kept in good order, rather too loose than too confined—let it have abundance of fresh air, and avoid making any changes of diet just when the teeth are coming through the gums—cooling drinks of water, or milk and water, or barley water, are useful to allay the thirst, and cool the hot mouth—a warm bath at night relieves the feverishness which is often present—and if the gums are swollen and inflamed, it may be necessary for the doctor to lance the gums—this gives very little pain, is followed often by great relief, and not unfrequently wards off a convulsion or other serious trouble. A quite unnecessary prejudice exists against this little operation, which is quite harmless, and may be productive of great good.

"The difficulties and dangers of dention may be reduced to a minimum by judicious diet and a strict observance of the con-

ditions of health. It is of the first importance that the child should have a plain, unstimulating, mostly milk, diet; and that it should be most carefully protected from cold and damp, for children are, at this time, if exposed to these influences, more liable to suffer from inflammatory diseases of the chest and air passages." In the earlier stages, while the teeth are "breeding" in the gums, the irritation may be relieved by gently rubbing them, or by giving the child a crust or an indiarubber pad to bite at; but shortly before they break through the gum the mouth is so tender that the child will allow nothing to go near it; and it is just at this time that the timely relief of lancing is of most service.

Bowels.—It is very necessary to attend to the condition of the bowels. When they go wrong, either by being too loose or too confined, we must generally look for the cause in the *diet;* and we must, accordingly, try and put matters right by making alterations in it, instead of by administering drugs to the child.

Diarrhœa.—If the child is on the breast, and the bowels become loose and slimy, the mother should examine carefully into her own condition as to food, exercise, and regularity of bowels and digestion, and correct anything she may find wrong there; if necessary, she should take a dose of castor oil or tincture of rhubarb, which will often set matters right. If, with all the attention she can give to her own condition, the child continues to suffer and begins to lose flesh, it is probable that her milk is unwholesome, and the child will have to be weaned, but before doing so she should consult her doctor.

In children brought up on the bottle, when the bowels go wrong, the strictest attention should be paid to the bottle and all that goes into it—see that it is perfectly clean and sweet, and free from the slightest sour smell. Get fresh milk twice a-day and raise it to the boil before using it; put barley water with the milk instead of water, and make the mixture weaker than before, and add to each half-pint two table-spoonfuls of lime water, or a few grains of bi-carbonate of soda;—give the child smaller quan-

tities at a time and feed it oftener. See that the child's bowels and feet are kept warm, and put a flannel binder round the body—a sudden chill is a very common cause of diarrhœa. If in spite of all care the diarrhœa continue, send for the doctor at once, rather than give it drugs yourself.

Constipation is commoner in children brought up on the bottle than in those fed at the breast. The natural tendency of the bowels is to regular movement once or twice a-day. If the stools are hard and lumpy, and the movements irregular and not frequent enough, the child is probably being overfed,—the meals should be lessened in quantity, no lime water should be given; one meal a-day of thin oat-meal gruel may be substituted for one of milk, or a table-spoonful of fluid magnesia may be put into the food once or twice a-day. If the bowels are loaded, a tea-spoonful of castor oil is useful to begin with, but the frequent use of purgatives only does harm, and should be avoided. An injection of two or three ounces of warm soap and water often gives relief. Thirty grains of manna in a table-spoonful of distilled water is a harmless laxative, and may be repeated twice a-day for a day or two, till the motions become more natural. But the chief reliance should be placed on lessening the quantity and altering the quality of the food.

A word or two on *Vaccination*. By the law of the land every child must be vaccinated before it is six months old. Living at this time of day we find it difficult to realise the state of matters before this most invaluable means of lessening the ravages of small-pox was discovered. It is a rare thing now to meet with a person marked with small-pox. There has hardly been a case of the disease in Edinburgh for the last eight or nine years, and only those whose duty it is to nurse and attend the sick, know what a terrible disease it is. This is not the time or place to discuss this question on its merits; I only ask you to think how terrible a disease it must have been, when, shortly after a young and fair queen of England had died of it, it was thought safer to give a milder form of the disease itself to every child by inoculation, rather

than let them run the risk of taking it in its more deadly form. By early and efficient vaccination we are almost perfectly guarded from this dread pestilence ; and it is the duty of every parent to see that his or her children have the benefit of this protection. I have had the opportunity of watching the course of more than one epidemic of small-pox: it was *invariably* caught first by those who had never been vaccinated: such were the first to suffer from it, and to bring and spread it to others ; and such were almost the only ones who died of it. I believe, and I wish all of you to believe, that *thoroughly efficient* vaccination is the one almost absolute safeguard against small-pox; and if perchance one so vaccinated person in a thousand do take the disease, he is almost sure not to die of it. And I would urge on all the importance of revaccination once after the period of childhood has passed; particularly if an epidemic of small-pox is threatened or actually present. If well carried out it makes the security well nigh perfect.

It is well to remember that children with irritable skins and of unhealthy bodies, sometimes have skin eruptions after vaccination; but such eruptions are not caused by the vaccination; they follow it as would and do follow any other irritation of the system, such as teething or an attack of diarrhœa. The best time to choose for vaccination is about the fourth month, while the child is fed entirely on milk and is in vigorous health, and before it has begun to be annoyed by the coming of the teeth.

Though we are not occupied on this occasion with the *diseases* of children, I cannot quite pass over one subject in connection with them, because it is so important. I mean the care that it is necessary to exercise when they are recovering from any serious illness. It is only too true that the children of the poor die of acute diseases, particularly measles, scarlet fever, and whooping cough, in far larger proportion than those of the wealthier classes. And the reason and the remedy are not far to seek. They are allowed to get up to run about and to expose themselves to cold a great deal too soon. The dangerous and fatal effects of cold on

the sensitive skin and chest of children just recovering from these diseases cannot be exaggerated. Multitudes of those whose deaths are recorded from the three diseases I have named really die from secondary disorders, which may be prevented by all, and are prevented by those who are fully alive to the danger. *The* disease which follows scarlet fever is disease of the kidneys producing dropsy. *The* disease which follows measles and whooping-cough is disease of the chest and lungs, producing bronchitis or pneumonia. The one cause common to all these secondary diseases is, I repeat, exposure to cold. Therefore I exhort you most earnestly to see to it that you do not swell the ghastly list of mortality by allowing your children to suffer from this cause. Do not let your children leave the house or be exposed to draughts for at least a month after the onset of either of these diseases in cold weather, and even in the height of summer the greatest care should be taken to see that they are thoroughly recovered from the first two and are over the worst of the whooping-cough before they are allowed to be exposed to the weather. The same caution holds good in relation to recovery from all serious disease.

In conclusion, I would urge on all the importance of beginning the education of their children while they are in the cradle. The first lesson a child learns—and it cannot learn it too soon—is that of order and regularity—regularity in feeding, in sleeping, in lying awake. It is as easy to teach a good habit as a bad one, and the after-results are infinitely more satisfactory. Implicit and ready obedience comes next, and this requires only firmness, kindness, and good temper to enable it to be carried out with perfect success. If it be ever necessary to beat a child, choose some part for making the application where you can do no harm. To box a child about the head or pull its ears is not only cruel but dangerous. Beware of frightening children by silly and alarming stories of bogies and hobgoblins, and particularly by shutting them up in the dark : a sensitive and timid child has by such treatment many a time had its mind seriously and permanently injured. Above all, it is to be remembered that chil-

dren are imitative animals, and will diligently follow, for good or for evil, the copy that is set before them. The influence of a good example in all relations of life will do more than anything else to bring up children as useful and happy members of society.

I have endeavoured in the foregoing remarks to put before you some of the principles which should guide you in rearing your children, and I have insisted most on those which are generally forgotten or overlooked. If they are common, simple, easy, every-day rules, there is all the less reason for neglecting them. It was once asked of old—"Did this man sin or his parents that he was born blind?" See that no man can ask of your little ones—"Did this child sin or its parents that it has grown up thin, and puny, and diseased?" There can be but one answer to such a question. I cannot conclude better than in the words of the great Hunter: "If you would have strong children, remember there are three requisites—plenty of milk, plenty of sleep, and plenty of flannel."

APPENDIX.

Rules for the Management of Infants.

1. *Warmth, Cleanliness, Fresh Air.*

Keep them warm : let the clothing be warm, but not tight. Wash them all over with soap and warm water daily, wiping them thoroughly dry afterwards. Give them plenty of fresh air : send them out, at least for a short time, every day that the weather is fine ; and, while they are out, air the room, by freely opening the window.

2. *Nourishment while the Child is under Seven Months old.*

The mother's milk is the most natural, and accordingly the proper food for infants. Therefore, if the mother has plenty of milk, let her suckle her child and give it *nothing else* till it is seven months old. If the mother has too little milk, still let the child have what there is ; and, in addition, cow's-milk and water, as directed in Rule 3. Till the child is seven months old, milk must be its *only* food.

3. *How to bring up "by hand."*

If the child *must* be brought up by hand, it should be fed with milk and water out of a bottle. At first, there should be nearly as much water as milk, but when the child is a month old, two parts of milk should be mixed with one of water : after this, the proportion of milk should gradually still further be increased, till, at four or five months, it is given plain. A teaspoonful of sugar

should be added to each bottleful, and the milk and water should in all cases be boiled first. If, at any time, the milk seems to disagree, a tablespoonful of lime water should be added to each bottleful. *Give the child no other nourishment whatever.* A very large number of the children that are brought up by hand die in childhood; and this mortality is for the most part due to the practice of beginning too soon with corn-flour and such like foods. These are not proper nourishment for children under seven months old, and should never be given to them. While the child is under a month old, do not give it more than half a teacupful of milk and water at a time. The bottle should draw easily. It should be very carefully washed out after every time it is used. Then bottle, cork, and tube should be kept separately in a bowl of clean water till next time they are needed. If the bottle is not quite clean, the milk may sour, and may thus make the child ill.

4. *Importance of Regular Feeding.*

The child should be put to the breast *regularly*: for the first six weeks, during the day, in general not oftener than every two hours; afterwards about every three hours. During the night, it does not need to be fed so often. A child soon learns regular habits as to feeding. It is a very great mistake to give the breast to the child whenever it cries, or to let it be always sucking, particularly at night: this is bad for both mother and child. If the child is brought up by hand, it should be fed with the same regularity: never give it the bottle *merely* to keep it quiet. If the child is weakly, the intervals between the feedings must be somewhat shortened, both during the day and during the night.

5. *Nourishment when the Child is over Seven Months old.*

If, at seven months, the child is strong and healthy and has cut a few teeth, it may now have one or two meals a day of milk slightly thickened with good well-baked bread or well-boiled porridge. *It should still have,* besides this, *plenty of plain breast or*

cow's milk. At ten months, it may, once a day, have a little meat-broth made with barley or rice, without vegetables. At twelve months, it should be taken from the breast. Till the child is two years old, no solid animal food should be given. *Even at two years, milk should still be the chief food.*

If, at seven months, the child is weakly or sickly, or is backward in teething, milk must remain the only food for some time longer.

6. *Avoidance of Stimulants, &c.*

Tea, beer, whisky, and other stimulants, cheese, fruit, and pastry, as also "soothing-medicines," "sleeping-draughts," "cordials," "teething-powders," &c., *should never be given;* and even ordinary medicines should, if possible, be given only after proper medical examination and advice.

THE USE AND ABUSE OF WATER IN HOUSES.

By Dr STEVENSON MACADAM.

On Saturday Evening, 22nd January, Dr Stevenson Macadam delivered the eighth of the Course of Health Lectures in the Free Assembly Hall, his subject being "The Use and Abuse of Water in Houses." Dr Macadam said :—

The water supply of a house must be regarded as one of the principal factors regulating the health of the people residing within the house. In importance it stands side by side with the air supply. Both minister directly to the sanitary condition of our homes, and on the use and abuse of air and water depends much of the rate of sickness, as well as of the rate of death in every family, and especially in the younger or child members, who are influenced much more by such agencies. What takes place in a single house is practically repeated in collections of houses, in villages in towns, and in cities, so that the air and water supply of a town very much determines the sickness and death rate of that town.

The special subject we have to deal with to-night is the water supply—"the use and abuse of water in houses." My duty will be to show you the way in which you can use water so that it shall best act as your health friend, and how also you can avoid the abuse of the water, and keep it from being a deadly enemy.

As we are in Edinburgh, I will deal with water affairs as we have them here, but I must not neglect an allusion to country districts as well, where some of us may go for work or for play, or at least where most of us have friends.

Water is so common a substance, that we are apt to forget how necessary it is to healthy life. People will scarcely take the trouble to think about it. They hardly consider it worth a few moments' consideration, and when they do think about it, it is generally associated with operations external to themselves. It suggests to the younger portion of the population especially, washing of hands and faces; to others, washing of clothes; to others, washing of houses; and to others, mere cooking of food, such as boiling potatoes or eggs; but scarcely does it ever suggest that it is absolutely *food* itself, and that of the structure of the bodily frame water constitutes a very large proportion; in fact, about three-fourths of the entire weight of the whole. It forms all the canals whereby the food is carried to every part of the body, the points of the toes, the tips of the fingers, and every nook and corner of the body, thereby sustaining the frame.

In fact, a man 12 stones in weight, if thoroughly dried, would give off about 9 stones of water, and only 3 stones of dried matter would be left. And every day a large proportion of this water is lost from the body, and must be replaced. An average sized man requires to replace from 70 to 100 ounces, or $3\frac{1}{2}$ to 5 pints per day, making during each week from 3 to 4 gallons of water. About one-third of the whole is got from the food he partakes of,—potatoes, beef, &c., and two-thirds, being $2\frac{1}{2}$ to $3\frac{1}{2}$ pints of water, must be supplied in drinking water, tea, or other liquids. Indeed, the best evidence as to the quantity necessary is derived from the Government regulations, which insist that in transport vessels, arrangements must be made that at least six pints, or three-quarters of a gallon of water must be supplied each day to every individual on board in temperate regions, and 8 pints or a gallon each day in tropical regions.

If we add to this the quantity necessary for personal washing purposes, as well as the washing of clothing, houses, &c., the amount runs up to 12 gallons, which may be regarded as the minimum quantity, and, of course, if you use baths, you must add some more to that, and so every person in the community ought to have about 25 gallons per day to keep up proper sanitary measures.

Where water can be readily obtained, we are not to regard this quantity as too much, having reference to cleanliness, and keeping our houses perfectly cleansed; in fact, to fulfil all sanitary requirements. In sickness even more is required, and for trade purposes in large communities a certain proportion still further. In ancient Rome they supplied an enormous quantity—a quantity that puts to shame all our modern notions regarding the supply of water to towns. They had a perfect stream of water carried by aqueducts into the city, 300 gallons being supplied per head per day

In country districts we are content with a great deal less than the proportions I have mentioned, but we must remember that the washing there is often done by the side of burns. In towns such as Edinburgh, people have little trouble with the water. It is brought to their houses, to the stairheads, or to the close end; and the authorities are bound to see to the quality being good. In fact, towns are very fortunate in this respect, for water brought in by pipes from pure country districts is mixed with country air, and if we use the water aright and do not spoil it in its use, we may have it in all its country purity.

Now, what are the sources of water which are introduced into our towns? Of course we sometimes say that the water is obtained from streams or burns or springs, but where do these obtain the water they supply to us? In dry weather they fall in volume, and in wet weather they increase in volume. Apparently there is something external to themselves, and ultimately you find that the rain and snow become feeders of our streams, burns, and springs, and keep up our water supply, or the

rain and the snow may sink a little and escape by drains, or sink still deeper into the ground and appear in the form of springs; but rain itself, and sometimes snow, are the sources of the water we obtain.

In speaking of the use and abuse of water, I should like to say something of its chemistry first. It is a substance which is clear and transparent—at least ought to be so—and which the chemist can now rend practically into two gases. I can take, for instance, some of the water here, and place it in this large vessel, and add to that a portion of the metal potassium which will act upon the water, and we shall find that the potassium seems to run about the surface of the water and take fire. What I have done is not so simple as it appears to sight. The action has been to rend from the water a certain amount of one of the gases in water called hydrogen, and it is this gas which takes fire and burns.

Again, taking the water and putting it into two glasses, I introduce zinc into the one vessel, and then put some iron filings into the second vessel. There does not seem to be any change, but if I now add a little sulphuric acid to these vessels efferves- cence at once takes place. Cover the vessels up and we shall collect a quantity of the gas coming away from the water. Bring a light near the vessels and the gas takes fire. This combustible gas is the hydrogen, which is merely part of the water, and which readily burns. In fact, we are rending away one of the ingredients of water, and that ingredient is one of the components which the chemist finds in water.

I should like to show some of the other properties of this gas hydrogen. I take this jar full of hydrogen, and then set fire to it, when you will find it burns very quietly and quickly, so that we have in water, as one of its components, a substance which enters into a state of active combustion. Luckily for us the water itself does not enter into such a state of combustion, but nevertheless it contains such a gas. I will show you another point connected with it. The hydrogen itself does not burn. If I take this vessel, containing the hydrogen, and set fire to

the contents, and bring the mouth of the vessel down to the table the gas goes out, because it requires air to burn it, as we require air to breathe; and it is only when you let plenty of air get into it that the substance burns itself out, so that hydrogen is a com bustible substance, and extremely inflammable when in contact with air, as we have shown by these experiments.

Then, again, hydrogen is a very light gas. I take here two jars containing the gas, and arrange to have one of them with the mouth upwards. I remove the cover from it, and so let the gas escape to the roof. The other I keep with the mouth downwards; the gas cannot get out, because it cannot escape upwards, and it cannot creep downwards through the heavy air surrounding the bottom of the jar. I apply a light to the first jar, and you see there is no combustible gas left in it, because the gas is all away. I take the other jar, which has remained with the open mouth downwards, and set fire to the contents, and you will find that the whole of the gas is there.

Again, here is a little pail at present full of ordinary air, which, when I bring over this light, does not burn, because there is no combustible gas in it. I put the pail into this jar, with the mouth downwards, and which is full of hydrogen, and after taking the pail out, I bring a light in contact with it, and the gas now in the pail burns readily. I take out another quantity and it burns again, and so on. Another way of showing the extreme lightness of this hydrogen is by means of this balloon, which I fill with the gas and then let it rise into the air.

You would fancy that as there are two elements in water they would be very like each other so that they might agree pretty well when united in water, but the chemist finds that such is not so, and if he separates the chemical compound water into its ingredients, that one of them is combustible and the other is not. I have in this vessel a quantity of the other gas that is present in water. It is equally a gas, and we give it the name of oxygen. Its principal property is that it does not burn itself, but enables other substances to burn in

it with extreme vividness. I take this piece of phosphorus and set fire to it. I place the jar containing the oxygen over the phosphorus, the effect being that it burns much more vividly. Every kind of water has always the same proportion of these two substances.

We have also in water a certain amount of what is called saline matter. A perfectly pure water would not be palatable. We would not care about drinking it, and it would not be so useful for cooking purposes as water containing saline substances. This saline substance is gathered in this way. The water falls on the ground, passes through the earth and rocks, and takes up a certain proportion of lime and salt, and so becomes more palatable and more healthy than if it were simply a mixture of the two gases I have mentioned. These saline substances I have mentioned are not deleterious, but are highly necessary for dietetic purposes.

Add a very little common salt, as I do here, to this water, and you will find that it gets dissolved, and that it does not give any different appearance to the water, while it is so small in amount that you could not even recognise the salt in the water by taste, but still it is present there. All the water we drink contains a certain proportion of common salt, and chemists recognise it by adding a solution of nitrate of silver, as I do here, which gives the water a milky appearance, which is presumptive evidence that there is a little common salt dissolved in the water. But in order to be quite certain about its being of the nature of common salt, I add some ammonia or hartshorn, and the milky appearance instantly goes away. That indicates to chemists the presence of the common salt, and the proportion of the milkiness produced by the silver salt is suggestive of the amount of the common salt.

Again, if you take and add to some water a little lime, the water gets more or less hard. Add to that water some oxalic acid with ammonia, and you get this white substance you see in the vessel, and thus the presence of lime is detected, and to make

more sure you add some hydrochloric acid, and you find that the white colour disappears entirely; so that in these different ways we have evidence of what water is when it is supplied to the town and is brought into our houses, and when we may consider it good water.

Now, water contains air mixed up in it, and as supplied to us from our pipes it has that pure mountain air—the pure country atmosphere—dissolved in it, and this adds to its palatability or taste and wholesomeness. We ought to keep the water as pure in our houses as when we get it from country districts, but unfortunately we often abuse it. Sometimes this is done in cisterns, which are never cleaned out at all, unless when some repair requires to be made. Sometimes, not so much in cisterns as in pails or other vessels in which water is retained, and which vessels are used for other purposes. Sometimes, water is deteriorated in jugs, pots, or pans which are not properly cleaned out, and all these affect the healthiness of the water, and render it more or less unwholesome.

Cisterns are not attended to as they should be. You will sometimes find them shut up in garrets, and in still more inaccessible places, where the woodwork is so thoroughly nailed up that no man can get in at them without breaking the place open. In Edinburgh and elsewhere I am quite confident that much sickness must accrue from the use of water lying in cisterns which are never cleaned out. I show you here a sample of water taken from one of the cisterns in Edinburgh to-day (producing a large glass jar containing water of a dirty brownish colour, with a quantity of sediment in it). Of course the water in the upper part of your cisterns may be quite transparent, but when you get down to one or two inches from the bottom you find a dirty-looking substance. Stir up this, an you will find the same substance as you see here.

I ask you, is it possible that water can be in a state of purity if it stands in our houses in such a state? Is it common sense that you should buy clean bread or beef, store both of them in a clean

place, and yet afterwards use these with such water? Is it common sense that you should store up water in your cisterns, into which cobwebs and street dust, insects and other animals find their way, and in which I have known the dead body of a mouse or rat to be found? Is it common sense that you should buy clean food and then cook it with water which has even stood for a single night over such deposits in your cisterns? That is one way in which people abuse water introduced into their houses in purity.

There is always more or less danger in the use of water if the cistern is neglected. If a man does not take much water from the cistern he allows it to flow out without great velocity, and this may not disturb the sediment. If, however, any one in the house wishes a bath in the morning, and draws off much water, there is immediately a rush in of pure water with great velocity, so that the sediment in the cistern gets disturbed, and the next operation is probably that water is drawn off for cooking purposes, bringing along with it more or less of this sediment. In the cleaning out of cisterns great care must be taken. I remember a case of a lady who instructed her coachman to clean out the cistern of the house. He, wishing to make a good job of it, got a bath-brick and a hard scrubbing brush, and got into the cistern, tackety boots and all, and brushed away till he could almost see his face reflected from the lead. The water which was then introduced came in contact with the bright lead, and immediately began to dissolve away the metal, and acquired poisonous properties. Lead should always retain its natural skin—the tarnished look, and if you wish to clean out your cistern properly, use the softest hearth-brush you can get. Let the water flow away, and move about this soft brush so as to stir up the sediment; then lift the waste-pipe and let the whole of the remaining water go.

I want you clearly to observe the enormous power which water has of absorbing gases, and to give you some notion that whenever gases come in contact with water, they are liable to become absorbed by it. I have got an arrangement to show this. Here

is some ordinary water, to which I add, in the first instance, a little colouring matter, so that we may see it in any vessel into which it may rise. I then take this large flask, which has a narrow glass tube inserted in it, to the top. We are going to fill this flask with a considerable quantity of gas, and for that purpose I will connect the tube which enters the flask with a second flask, in which I place a small quantity of ammonia, which I can drive off in vapour by applying heat to the second flask. There is a long flexible tube that terminates in the narrow tube of the first flask into which I am going to drive the ammonia vapour. I wish by this experiment to show you how water absorbs gases, as I believe much injury arises not only from the deposits in water, but likewise from the water having gases absorbed in it, through the cisterns being in such positions as necessitates gases being absorbed by the water. I know by the odour of hartshorn that we have got sufficient in the flask, and I place the mouth of the flask in the jar containing the coloured water, which you see now rises into the flask, quite absorbing the gas, so that the water is actually sucked into the flask.

Water, therefore, has the power of absorbing gases which may be given off from deposits in the cisterns, or otherwise near the cisterns; in such circumstances, therefore, we should be careful about our cisterns, and remove those ugly deposits which are liable to be present. We should also put the cisterns in such positions in our houses that pure air could flow over the water, rather than allow stagnant and foul air to come in contact with the water, of which I am sorry to say there is too much.

Water is also liable to be contaminated when put into pails which are not properly cleansed. We can only hope in many of the smaller houses to have the water supplied in pails, but I am afraid, from practices which go on occasionally, it is a very common thing for washing-water and slops to be taken out in the pails, after which they get a little rinse out, and then pure water is poured into the same pails, and taken into the house. Now, that is a great source of the contamination of water. Water taken from such a pail

would not now-a-days be passed for dietetic purposes as pure water by any chemist in the country. I take here two vessels which are clean just now. I put into this one a material which may be called to some extent polluted, and I roll it round the side of the vessel, and then pour it out, and I fill up the two jars with portions of the same water. There is an easy sort of way to test such water, and that is by using a coloured substance, Condy's fluid, which I have here, though that is not always a safe guide. I pour half of the coloured liquid into this vessel, where we have no reason to believe there is any impurity, and you will find there is a nice pink colour distributed throughout the vessel. But if I take the other half of the coloured liquid, and add it to the contaminated water in the dirty vessel, the pink colour disappears, owing to the impurity in the water. We can thus demonstrate that water can become impure in these pails, and prove the necessity for thoroughly cleansing out all vessels intended for conveying or retaining water.

The gases we previously spoke of may be accompanied by certain germs which are hurtful to us, and which, though invisible to us, may still be floating about in the atmosphere and water. I have got here a bottle which contains a little chlorine, and which is a very powerful agent in our work. I have also some turpentine, which is perfectly clear and transparent, and I take a piece of thin paper, which I intend as a means to introduce the vapour of the turpentine into the bottle. I pass the paper through the turpentine, and you see that though it becomes wetted there is no essential change in its appearance. In the atmosphere surrounding the paper, there is now the vapour of turpentine, though such is invisible, and such turpentine, like the noxious germs in polluted air and water, contains carbon particles. I put the paper with the turpentine into the bottle of chlorine, and separate the carbon. You find there is a disengagement of vapours, and the side of the bottle becomes coated black with the carbon.

I would advise that no pail or vessel should be employed for pure water that is used for slop water at all. Nothing is better

for the conveyance of pure water than a good tin can or pail with a cover on it. Never use a galvanised iron pail, which is apt to give a zinc taste to the water, and render it nauseous and more or less unwholesome. In regard to jugs, pots, pans, and dishes, these, of course, should be washed immediately after each meal, for if they are not it is difficult to remove the organic matter attached to them.

In the use of water for cooking, there is a practice in many houses of using reboiled water, which has been boiled, simmered, and then boiled again in a kettle or pot, and after that the meal is cooked with it. If, however, fresh water were introduced each time, it would make the food more palatable. The water ought to be put into the vessel cold, and when it comes to the boil, be instantly employed for dietetic purposes. I instance tea especially, which would be better tasted by following this advice, and the extra two or three minutes required for the operation would be very well spent indeed.

I have referred to water standing in our cisterns, and I have to tell you now never to use stagnant water whether in cisterns or in pails. After cisterns have not been used for two or three days, run the whole of the water off, and introduce fresh water. As to filters, after being used for two or three weeks, they get worse than useless. They retain the impurities which get lodged in them; and warmed by the temperature of the room in which they may be situated, they contaminate the water more than if you had never used the filters at all. Filters, too, on the large scale, after being in use, become infected with organic matters, and should be cleansed; such matters, certainly, do not conduce to the healthiness of the water.

In country districts they are much worse off than we are in towns for water supply. Wells, and sometimes ditches, are resorted to, and in getting rid of the slops the readiest and easiest is generally the method adopted—that of throwing them out on the road in front of the houses. And now let us see what is done in regard to houses in country places. A man often goes

and builds a house in the country, in a spot selected without reference to water supply; and after he has put up his house, then he begins to think about water. In many cases he finds that the easiest and cheapest way is to dig a hole near the house, which he calls the well. The water is introduced into his house, and he uses it for all purposes. He must, however, get rid of the dirty water, and he digs another hole to receive it. He leads a pipe from his house, and runs all the impure waters into that second hole, which he calls his cesspool. The well must have water, and as the cesspool begins to get filled up with water containing some not very nice things, the liquid contents find their way through the earth towards the well, and the water becomes impregnated with organic matters. The result is that in a very short time—it may be after having been in the house for a few months—illness breaks out in the family, and the householder cannot understand what has caused the illness in the family. Again, another man may build a house close by the ground where the first cesspool is situated, and of which he knows nothing. He also wants to get a supply of water, and digs a well which may be close by his neighbour's cesspool, probably within three feet of it. The matter from the cesspool of the first party finds its way into the water contained in the well of the second, who also begins to wonder why he should not enjoy the best of health. Again, a whole row of small houses may be built, and a well be put down beside them. All the dirty water may be thrown out into a gutter near the well, and the result is the contamination of the water.

In these observations which I have made, I have endeavoured to give you some notion as to the manner in which we ought to use water, and as to the manner in which I am sorry to say we abuse it. One word as to impure water and its effect upon health. There can be no doubt of cases where contaminated or impure water has led to ill health, and where noxious germs are introduced into the system by means of liquids such as water and milk, through which they are at once carried into the system. Nowa-days it can hardly be a question whether impure water engenders

disease, and there can be no question whatever that bad water influences the healthy state of the animal frame, predisposes individuals to attacks of illness, and thus aids and abets the propagation of disease. Its action is markedly observed in cases of diarrhœa, cholera, and typhoid fever. I have had a good deal to do with the shutting up of wells in districts where such illnesses prevailed, especially over the Fife district during 1866. It was wonderful how these polluted wells became the means of promoting that dreadful disease cholera, and medical and sanitary officers recognised this fact. One wrote me saying: "It is a remarkable fact that the deaths from cholera were chiefly, if not altogether, in the vicinity of these wells." Another wrote: "On learning the result of your analysis the well was shut up, and the attacks then ceased." I need hardly say, because it is a matter which has occupied much public attention lately, that typhoid fever is also spread by such impure waters. The use of such water also lowers the tone of the system, and renders the man or woman less fit for work.

An abundant use of water ought to be encouraged. The deficient use of it means personal cleanliness not attended to, clothes not properly washed, rooms not thoroughly cleaned out, and cooking not the most cleanly. To talk of the waste or the abuse of water in its liberal use, or to stint its use in any way in our houses, is false sanitary doctrine and practice. I would like to see a more liberal use of water in Edinburgh for private and public purposes. Why should we not have public wash-houses, under municipal control, in various parts of the city where, for a few pence, there could be secured hot and cold water, washing tubs, and drying arrangements for the most homely of washings? Why should we not have public baths under municipal control, distributed here and there over the town, where on Sundays or week days, for a copper or two, any man or woman, boy or girl, could thoroughly cleanse themselves? Other towns and cities have such advantages in abundance, and Edinburgh, with its large supply of fresh water and a

near supply—which could be readily obtained—of salt water, should not be behind other places. And more, why should we not have flushing stations in connection with all our main drains, where a large body of water could be regularly sent down our sewers to flush out all impurities, and in conjunction with open street grating-ventilators, purify the sewers?

Sanitary science demands that water should be supplied and be used in populous places without stint. We ought, therefore, to encourage its use instead of discourage such. Air and water are public property, and any proposal to restrict their use is not sound sanitary policy. A disuse of water, or a scanty measure of it, is not only an individual disaster but a public calamity. Pure wholesome water is a mighty blessing, and happy the town which can command plenty of it.

APPENDIX.

THE USE AND ABUSE OF WATER IN HOUSES.

The Water Supply of a House is one of the principal factors which regulate the health of the people residing within the house.

In importance it stands side by side with the air supply. Both minister directly to the sanitary condition of our homes; and on the use or abuse of air and water depend much the rate of sickness and even the rate of death in every family, especially in the younger children, who are much influenced by such agencies.

The Water Supply of a house is not only useful for washing and cooking purposes, but it is *food* itself. The bodily frame consists of water to the extent of three-fourths of its entire weight; and water forms all the canals whereby the ordinary food is carried to all parts of the body.

About 70 to 100 ounces, or $3\frac{1}{2}$ to 5 pints, of water are required every day to replenish the loss of water from the body of every man and woman, one-third of which is obtained in the bread, potatoes, beef, &c., and the remainder, being 50 to 70 ounces, or $2\frac{1}{2}$ to $3\frac{1}{2}$ pints, must be taken as drinking water, tea, &c.

Washing of the person, with an occasional bath, washing of clothes, washing of dishes, and washing of rooms and furniture, require much extra water, so that where the water can be easily got at about 25 gallons should be used for each person during each day.

Towns, such as Edinburgh, are fortunate in having the water brought in from country districts, mixed with country air, and led into our houses, or at the stair head, or at the close foot, and if we use the water aright we can drink it with all its country purity.

In the Use of Water in Houses we should endeavour to keep it as pure as we get it, but, unfortunately, we often abuse it, foul it, or dirty it, within our own reach.

Sometimes cisterns are never cleaned out.

Sometimes water pails or other vessels are used for other and less cleanly purposes.

Sometimes jugs, pots and pans, and dishes, are not properly cleaned.

The Cisterns are liable to have deposits settling in them, consisting of earthy matter, street dust, insects, an occasional rat or mouse, etc., which give off noxious matters to the water; and from the position of the cisterns in many houses, noxious gases are also liable to be absorbed by the water.

Pails, Stoups, and Cans, used for bringing in water into houses, are often used for washing purposes, or for taking out slops.

If the house has a cistern, see that it is occasionally cleaned out with a soft brush, lift the waste pipe, and let the dirty sediment escape. If the water is taken into the house in a pail or other vessel, never use such for any other purpose. The best and most cleanly vessel to use, is a tin can or pail with a tin cover. Do not put clean water in a galvanised iron pail.

If you go to the country for work or otherwise, be careful where you get the water. Many well waters are polluted and unwholesome. See that no slops are thrown out near the well, or dung-heaps or ash-pits situated there. Running water is often more healthy than well water.

Impure Water leads to ill health. Noxious germs are liable to be carried into the system, and if not directly causing disease, at least predispose people to attacks of disease, such as diarrhœa, cholera, and typhoid fever, and even where no serious disease breaks out, the impure water lowers the tone of the system and renders the man or woman less fit for work.

Use water abundantly. A deficient use of water means

Personal cleanliness not attended to.
Clothes not properly washed.
Rooms not thoroughly scrubbed out; and
Cooking and dishes not the most cleanly.

The Abuse of Water does not lie in the large or liberal use of it, but in rendering what we do use uncleanly, and unfit for healthy use.

Always keep the sink and closets—whether in the house or on the stair head—very clean, and use plenty of water for the purpose. Do not stint the use of water for flushing sink and closet pipes. A good rush of water will carry away obstructions and keep things sweet.

THE USE AND ABUSE OF ALCOHOLIC STIMULANTS AND TOBACCO.

By PROFESSOR THOMAS R. FRASER.

On the Evening of Saturday, 29th January, Professor Fraser delivered the ninth of the Course of Health Lectures in the Free Assembly Hall, his subject being "On the Use and Abuse of Stimulants and Tobacco." Professor Fraser said:—

Ladies and Gentlemen,

We have all heard of the young man who has no vices. He has been held up before the youth of this country—and probably of many other countries—as a model to be imitated; but, unfortunately, the model has not been adopted so generally as to give complete satisfaction to fond wishes and affectionate interest.

We who are familiar with this model, are aware that the vices from which he is free are chiefly those which are included in the subject of my lecture this evening. I shall have much to say of the vicious results that follow the *abuse* of stimulants and tobacco; but you will observe, the title of my lecture imposes upon me the duty also of considering their *use.*

This title is not one for which I am responsible, but I am not sorry that it has been selected.

The subject of the use and abuse of stimulants and tobacco has for some years largely engaged attention. It has been considered by medical men, by physiologists, by politicians, and by social reformers, and the greatest benefit has already resulted from this consideration. I cannot avoid thinking, however, that the benefit might have been even greater than it is, had social reformers—

with the best of intentions—exercised a little more caution in the statements and arguments by which they have endeavoured to advance their opinions. Enthusiastic for the good of their fellow-men, they have at times been led by their enthusiasm to ignore what has not been proved to be bad, and to exaggerate what is assuredly bad. They have neglected the *use*, and perhaps exaggerated the *abuse* of stimulants and tobacco; and by so doing it is to be feared they may have impeded the progress of the reforms they so ardently desire. Had they submitted to the wise dictation of a public-spirited committee, such as that which has so admirably arranged this course of lectures—and in whose praise I can speak with all the more freedom because I do not even know their names—some of these errors would have been avoided by the restraints and guidance of an imposed title.

There are few things of the nature of luxuries which are so largely consumed as stimulants and tobacco. Understanding by stimulants, alcoholic beverages, it is not too much to say that the consumption in this country is represented by millions of ounces of alcohol, while that of tobacco is represented by millions of pounds; and I need not remind you that this country has no monopoly in the consumption. Alcohol, in some form or other, is used as a drink by the majority of the inhabitants of nearly every country, and there is no nation in the world to whom the use of tobacco is unfamiliar. The prevalence of this consumption over the whole world, and among individuals of every class, of every occupation, and of every degree of moral and mental condition, is in itself a strong reason for avoiding indiscriminate or intemperate attacks. It is useless to attribute this extensive use to mere imitation or inherent vice. Some effects must follow which are pleasing or beneficial; and if the evils of abuse are to be rationally met, these effects should not be ignored, but should be dispassionately considered along with those that are productive of mischief. Now, ladies and gentlemen, I think it will be most convenient if, in what I am about to say, I first of all speak of the effects of stimulants, and then of tobacco.

STIMULANTS.—By "stimulants" I think we all mean beverages that are capable of producing in large quantities intoxicating effects. I do not think, when we use this word, we generally mean such substances as tea and coffee, though they also may be correctly spoken of under the same designation. The stimulants I wish to say a few words about to-night, are such beverages as whisky, wine, and beer, all of which owe their leading properties to a liquid contained in them called alcohol, which you may know in its nearly pure form of "spirits of wine." For this reason, they are spoken of as alcoholic stimulants. In whisky, wine, and beer, the alcohol is mixed with water, and, accordingly, the alcoholic strength of these beverages varies considerably, as you will see from the table :—

TABLE I.—Percentage by volume of absolute Alcohol in several common Alcoholic Beverages, with the quantity of the Beverage representing about one ounce of absolute Alcohol.

BEVERAGE.	Percentage of absolute Alcohol.	Average percentage of absolute Alcohol.	Quantity representing about one ounce of absolute Alcohol.
Spirits—			
Brandy	50 to 60	50	2 ounces, or 1 small wine glass.
Whisky	50 " 60		
Gin	49 " 60		
Rum	60 " 77		
Strong Wines—			
Sherry	16 " 25	20	5 ounces, or 2 wine glasses.
Port	16 " 23		
Madeira	16 " 22		
Marsala	15 " 25		
Light Wines—			
Bordeaux (Clarets)	6·8 " 13	10	10 ounces, or 4 wine glasses.
Rhone	8·7 " 13·7		
Champagne	5·8 " 13		
Malt Liquors—			
Beer, Ale, Stout, Porter	1.2 " 10	5	20 ounces, or 2 tumblers.

They may also contain sugar, acids, and other substances which produce some differences in their effects. Their chief effects, however, depend on the alcohol they contain, and for the sake of simplicity, therefore, we may ignore the other substances, and consider only the effects of the alcohol.

Let us consider these effects; but before doing so in detail, I should first point out that they vary greatly according to the quantity that is taken. This is so obvious, I need scarcely dwell upon it. We know that with everything that produces effects the quantity that is taken modifies the degree and apparently even the kind of the effects. A small pinch of salt is a pleasant and almost indispensable addition to the meat or potatoes we eat; but one or two tablespoonfuls of it produce very quickly sickness and vomiting. A very little whisky and water makes one feel warm, and perhaps a little light in the head; a wine glassful of whisky will make many people intoxicated and unable to walk steadily or speak distinctly; and a tumblerful will soon render them insensible, and probably act so decidedly as a poison that it will quickly produce death.

In speaking, therefore, of the effects of alcoholic stimulants, we must bear in mind the differences in the effects that are due merely to the differences in the quantity taken.

First let me speak of the effects or action upon the stomach and digestion. When a small quantity is taken, the juices which are poured out from the stomach walls, and which are necessary for the digestion of food, are increased, and the food is more rapidly and thoroughly digested. This occurs only if the small quantity is mixed with much water—is well diluted, in short—and unless it be well diluted, digestion is not made more rapid, but it is impeded and less perfectly performed than it should be. Heartburn, pain, and other signs of dyspepsia follow, and they become uncomfortable and only too familiar monitors, whose hints are, however, very frequently neglected by those who habitually partake of undiluted or insufficiently diluted spirits when there is little or no food in the stomach. If the insuffi-

ciently diluted spirit, or even if sufficiently diluted spirit be often taken, then the structure of the stomach becomes changed. It becomes inflamed and thickened, and incapable of producing a large enough quantity, or a proper quality, of gastric juice to digest food; and from this it follows that dyspepsia of a lasting or chronic kind is caused.

When the alcohol is introduced into the stomach, however, it does not remain there. Part of it at once passes into the blood-vessels in the walls of the stomach, and is in that way carried through the whole body. Many other parts of the body besides the stomach are consequently affected by it. Even a small dram, for instance, makes the face, neck, and hands redder than they previously were; showing that the state of the circulation has been modified. If we examine the circulation a little more, we will find that the pulse at the wrist beats faster, and becomes larger and more full, and that the strokes of the heart are stronger. When these changes take place, we know that the blood is flowing more quickly and in larger amount; and that this implies an increase in the supply of blood to the different organs of the body. Such an increased supply is very likely to be followed by an increase in the activity of the organs receiving the blood, for their activity depends partly upon the quantity of blood they receive. I wish to direct your attention particularly to this action of alcohol, for it is the action which has led chiefly to the reputation alcohol has gained as a *stimulant;* as a substance which stimulates or excites, for example, the appetite, or the digestion, or the brain, and which makes it remove the general state of the body which we speak of as fatigue. Now, I think there can be no doubt that it does all this; but you are not to think that it is the only substance which can do it, and much less are you to think that it can be used for this stimulating purpose without risk. The conditions in which it may be employed are those in which the parts of the body I have referred to are in an abnormal or not perfectly healthy state, and accordingly it should be used as a stimulant only in those states. In a healthy state,

the stimulating action results in the production of injurious rather than of beneficial changes, even if only a moderate quantity be taken, and much more if a large quantity be taken; or if any quantity able to produce distinct stimulation be frequently taken. If, indeed, a large quantity be taken, stimulation is not observed, but an opposite effect. The large quantity undoubtedly acts as a poison, quite as distinctly as arsenic or prussic acid: and in books on poison, instances are recorded in which death has followed a short time after the drinking of large quantities of alcohol in the form, for example, of whisky.

The stimulating effect upon the circulation is, in other respects also, of an undesirable description, and it is not generally productive of real benefit to the individual. For example, it has led to the notion that alcohol is able to make one warm, that it is a substance that raises the temperature of the body. This notion is very much due to the sensation of heat, to the glow which results from the blood-vessels of the skin becoming dilated. It prompts the street porter to make frequent visits to the convenient public house during cold weather, and the driver of the stage coach to take a "glass" at each inn before whose door his coach draws up. But it is entirely erroneous for them to suppose that each glass of whisky actually increases the temperature of their bodies. The dilated blood-vessels which suggest to them that alcohol is a warming substance, in reality cause a reduction of temperature, by permitting a rapid cooling of the blood when the surface is exposed to cold; and therefore the street porter soon fancies that another glass of whisky would do him good, and the coachman is only too impatient to see the sign-post of the next inn. The dilated vessels also permit of a *sudden* cooling of the blood to take place; and so it is that diseases of the kidneys, of the liver, and of the brain, which are of frequent occurrence in those exposed to vicissitudes of climate, are not altogether to be explained by climatic influences.

This dangerous or bad effect of alcoholic stimulants has, I have little doubt, been productive of much injury during the Arctic

winter, which I trust has now left us. We know that it actually does so in the Arctic regions. Travellers have found that in any shape they are not only completely useless, but positively injurious. They stimulate for a short time, and make one feel warm for a short time, but exhaustion occurs more quickly, and the cold becomes more difficult to bear when they are used. The last Arctic Expedition from this country—that of Sir George Nares—was not so successful, you may remember, as everyone wished; and the committee which enquired into the causes of its failure had a great deal of evidence brought before it by the officers and sailors who took part in the expedition, and also by many former Arctic travellers, as to the value of stimulants and different foods in cold climates. I see that Admiral Inglefield—with whom I served as a member of the committee—has written a letter which appears in to-day's *Scotsman*, in which the result of that evidence is very fairly stated. It was that to take alcoholic stimulants to keep out cold is a fallacy, and that nothing was more useful for that purpose than a good fatty diet, with hot tea or coffee, and not spirits, as a drink.

This was also the experience of the leaders of Napoleon's campaign into Russia, and the monks of St Bernard find that death from cold is hastened by alcoholic drinks.

Let us now consider if the nutrition of the body is in any obvious manner affected by alcohol. It is every day observed that many drinkers of alcohol grow stout, and even uncomfortably fat. The explanation of this is to be found in the fact that alcohol lessens the waste of substances in the body, whether these be of the nature of food or of formed tissues, and also somewhat facilitates the absorption of the fatty portions of the food from the stomach. We accordingly see why those who drink alcohol even moderately, especially if at the same time they consume food rich in fat (or what leads to the same result, in sugar or starch), are apt to become stout from a deposit of fat taking place under the skin; and why those who take alcoholic stimulants immoderately are, in addition, very likely to have fat deposited in some of

the organs of the body, where its presence constitutes the disease, fatty degeneration.

We are, also, able to understand why stimulants, which not only stimulate, but also lessen the changes in the constituents of the body and of food, are for this reason specially injurious to young persons. The forming of the tissues and structures of which the body is composed requires that the constituents of these tissues, and the foods from which they are made, should be allowed actively to rearrange themselves into appropriate forms and compounds, and everything which interferes with these rearrangements retards growth and nutrition. As growth and nutrition should be allowed to proceed unchecked in persons whose bodies are growing, alcoholic beverages must act most injuriously on young persons, and, apart from every other reason, their frequent use, and much more their use as daily articles of consumption by children who are not suffering from illnesses which may require them to be given medicinally, is undoubtedly prejudicial to their physical development.

It is, however, commonly asserted that alcoholic stimulants are *foods*. A great deal of trouble has been taken to find out if this is the case or not. I think some of the most satisfactory, because eminently practical, observations that exist to assist us in deciding this very important question have been made by a distinguished physiologist and physician of America, Dr Hammond. He tested the food value of alcohol upon himself in this way: During a few days he lived on a diet that was *sufficient* to maintain the body at the usual weight and in a healthy condition; during a second equal number of days he lived on a diet that was *insufficient* to maintain the body at the usual weight, for while living upon this diet weight was lost; and during a third equal number of days he lived on a diet that was *more than sufficient* to maintain the body at the usual weight. During each of these three series of days he daily took the same, and only a moderate, quantity of alcohol in the form of wine. He found that the addition of alcohol had the effect of increasing the weight of the body,

whether the food was sufficient, insufficient, or more than sufficient in amount—a result which you are not unprepared to learn from what I have already told you of the effect of alcoholic stimulants upon nutrition. He found, however, more than this; for while the alcohol seemed to supplement the deficiency of food when an *insufficient* diet was taken, it produced disturbances in health when the food was either sufficient or excessive in amount, such disturbances, for example, as palpitation, rapid pulse, dyspepsia, laziness, and indisposition for mental or physical exertion —the disturbance of health being greatest during the days in which an excessive amount of food was taken.

There is one lesson, at any rate, which these experiments most emphatically teach, and that is that alcoholic stimulants are altogether unnecessary as foods when a sufficient quantity of ordinary food is being taken.

When the food is sufficient, or more than sufficient, they produce disturbances in health, some of which I have told you of. They were produced within the very few days during which Dr Hammond's experiments were continued. But in the numerous experiments, for objects totally unconnected with science, which are being made on all sides and by all classes, the use of the alcoholic stimulants is not restricted to a few days or even weeks, and the effects produced are not the mere temporary ones that I have mentioned. These temporary effects are to be explained by the alcohol acting directly upon the stomach, and then, after it is absorbed into the blood, acting upon the heart and blood-vessels, the brain, liver, and many other important organs. If such consequences can follow an action restricted to a few days, it would be foolish to suppose that more serious and more permanent effects will not follow an action extending over months and even years. It would also be contrary to the facts daily brought under notice to make this statement. We physicians have unfortunately only too good reason to know that the stomach becomes unable properly to digest food, that the brain become enfeebled, that the liver and kidneys become unable to perform their necessary

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functions, and that the heart and blood-vessels become unfitted to circulate the blood, as a result of disease in the structure of each of these organs, directly caused by the habitual use of alcoholic stimulants in excessive quantities, and even in quantities which many persons would not regard as excessive.

One of the series of experiments I have referred to indicates that alcohol may act as a food. Its applications as a food are very limited. It may supplement an insufficient dietary, where insufficiency is an unavoidable condition; and illustrations of this use of it are to be found in the records of sieges, as in that of Paris during the last Franco-German War. It is to be recollected that it is an expensive food, and also that, while it acts as a food, it at the same time lessens the activity of nutrition, upon which the production of force depends. Men undergoing great and prolonged physical exertion work as well, if not better, without alcohol as they do with it. The experience of recent campaigns which have been successfully conducted on total abstinence principles, have proved that men *in a healthy condition, and supplied with a sufficient amount of food*, retain their health and are capable of performing the most arduous labour, in every variety of climate, without alcohol. And further, in some of these campaigns, opportunities were afforded for observing that the addition of alcohol to the diet may actually diminish the capability for prolonged physical exertion.

When we direct our attention to mental work, I believe the same conclusion must be arrived at. The stimulating action on the brain of quantities far short of intoxicating, is accompanied with a paralysing action which seems most rapidly and powerfully to involve the higher faculties. Mental work may seem to be rendered more easy, but ease is gained at the expense of quality. The editor of a newspaper will tell you that, if he has been dining out, he cannot with confidence write a leading article until he has allowed sufficient time to elapse for the effect of the wine he has drunk, in moderation, to pass away; and even the novelist, whose brainwork is in the regions of imagination, will relate a similar experience.

Now, ladies and gentlemen, I have to some extent illustrated the results that follow the use of alcohol and the injurious consequences that follow its abuse. The latter, as we have seen, include the production of several diseases; and as you might expect, these diseases have an effect upon the duration of life. Let me now direct your attention to some tables in which this effect is plainly shown:—

TABLE II.—Ratio per cent. from the undermentioned Causes to Deaths from all Causes.

Cause of Death.	1847.	Gotha Life Office.	Scottish Widows' Fund.	Intemperate Lives.
Head diseases, . . .	9·710	15·176	20·720	27·10
Digestive organs (especially the liver), . . .	6·240	8·377	11·994	23·3
Respiratory organs, . .	33·150	27·843	23·676	22·98
Total of above three classes, ...	49·100	51·396	56·390	73.38

TABLE III.—Expectation of Life among the Temperate and Intemperate. (Derived from rather limited data.)

A Temperate person's chance of living is—	An Intemperate person's chance of living is—
At 20 = 44·2 years.	At 20 = 15·6 years.
,, 30 = 36·5 ,,	,, 30 = 13·8 ,,
,, 40 = 28·8 ,,	,, 40 = 11·6 ,,
,, 50 = 21·25 ,,	,, 50 = 10·8 ,,
,, 60 = 14·285 ,,	,, 60 = 8·9 ,,

TABLE IV.—Mortality among Intemperate Spirit and Beer Drinkers.

Spirit drinkers, ...	5·996 per cent.	(nearly 60 per 1000).
Beer drinkers, ...	4·597 ,,	(nearly 46 per 1000).
Spirit and beer drinkers, . .	6·194 ,,	(nearly 62 per 1000).

This effect upon the duration is also shown when a comparison is made between the expected and actual claims in the tem-

perance and general sections of insurance companies. In the case of one insurance company, the results of such a comparison have been communicated to me through the kind interest of one of my colleagues, Professor Calderwood. It shows that while the claims in the temperance section are 30·5 per cent. below the expected claims, in the general section they are only 0·7 per cent. below the expected claims.

The statements I have now laid before you are sufficient to show that the use of alcohol is very limited, while its abuse is productive of many injurious consequences. Its employment as a daily beverage cannot be justified on the ground that it increases the capacity for work, that it makes the body warm, or that it acts in ordinary conditions as a food. We are entitled to assert that the chief justification that can be advanced is that it is a luxury. No doubt, to many, the reprehensible pleasure of intoxication, in some of its degrees, is the main inducement that leads to abusive indulgence in it. In that case, it certainly leads to, if it be not a mere evidence of, mental and physical degradation. But, whatever be the inducements to immoderation, we must not conceal from ourselves that it is often originated and strengthened by erroneous notions regarding the effects of alcoholic stimulants, and by the conditions in which many persons exist.

Too often a craving for alcohol is originated and encouraged by insufficient and badly cooked food, and by the overcrowding and the defective ventilation of dwelling-houses.

The removal of the erroneous notions to which I have referred will probably effect much good; and a great reduction in the amount of intemperance may be expected to follow the improvements which are now being carried out in the sanitary condition of our large cities.

TOBACCO.—I pass, with some relief, to the consideration of the second subject on which I have to-night to say a few words, because I do not think it can be proved, whatever assertions may be made, that the moderate use of tobacco is followed by so many evil consequences, nor even that its immoderate use is so likely

to lead to such serious diseases of the body and mind as may justly be attached to the abuse, or even to the injudicious use of alcohol.

It may interest you to know that tobacco is made from the leaf of an American plant called *Nicotunum Tabacum;* and that it appears to have been employed for smoking by the natives of South America from time immemorial. Some of its properties were first learned by Europeans, through the enterprise of the famous discover, Columbus. In 1492, when his ships were lying off Cuba, he sent two sailors to explore the island, and on their return, among other wonderful things they reported, was a custom of the natives to puff smoke from their mouths and noses. Other travellers had their curiosity excited by observing this remarkable habit among the natives of different parts of the New World; but tobacco was not introduced to the Old World until nearly a century afterwards. The origination of the custom of smoking in this country is generally attributed to Sir Walter Raleigh, who certainly made it fashionable, and gave it "a good standing in society;" so that in a short time to smoke "with a grace" was looked upon as a necessary accomplishment of a gentleman. Among the uninitiated the custom excited wonder, and sometimes alarm. It is recorded, for example, that on one occasion when Sir Walter Raleigh was taking a "private pipe," a servant entered his room, and seeing the smoke proceeding from his master, concluded that he was on fire, and thereupon threw the contents of a jug of ale over his face to extinguish the conflagration.

The custom of smoking also excited much opposition. Pagan, Mahommedan, and Christian monarchs combined to check its progress. Edicts were promulgated and books written with this object; and one of the latter still survives as a protest against tobacco smoking. This is the "Counterblast to Tobacco" of King James the first of England, in which the following passage occurs:—"Surely smoke becomes a kitchen farre better than a dining chamber; and yet it makes a kitchen often times in the inward parts of men, soyling and infecting with an unctuous and

ugly kind of soote as hath been found in some great tobacco takers, that after death were opened. A custom loathsome to the eye, harmfull to the braine, dangerous to the lungs, and in the black stinking fume therof, nearest resembling the horrible Stygian smoke of the pit that is bottomless."

Opposition, however, was of no avail. The custom continued to spread, until it became common among the inhabitants of every known country.

Now, what is the reason of this extension and prevalence? Are they to be accounted for by that spirit of opposition in the human disposition, which is said to induce tenacity of adherence to customs and opinions which are intemperately censured, especially when to intemperate censure is added an exaggerated statement of evil effects, such as characterises the "Counterblast" of King James? Or is the explanation to be found in the fact that the custom itself is not only free from the direful effects that have been attributed to it, but even that it is productive of some effects of a useful description? It is impossible to answer these questions until we have considered the influence that tobacco exerts upon the human body.

Its attractions certainly are not manifest on a first introduction. The first pipe is generally a horror which is not soon forgotten. The novice discovers he has a stomach, he becomes acquainted with the sensations of utter prostration. Even after familiarity with the indulgence, a temporary excess soon conveys an unmistakeable warning of the activity of tobacco. Should this warning be neglected, then we know that life may be endangered, for there are instances of death from smoking. This has occurred in a novice after only two pipes, and in habitual smokers after seventeen or eighteen pipes were continuously smoked.

These disagreeable and dangerous effects cannot certainly constitute the attractions of tobacco smoking. If you ask a smoker why he smokes, I am afraid the answer will generally be an un-

satisfactory one. Very often it may be, because a soothing, tranquillizing effect is produced, because mental work or physical exertion is rendered more easy, or because it assists to kill spare time. These or similar reasons, or excuses, are often advanced as a justification of the indulgence, and I do not think you will be prepared to say that, if they are the actual effects of smoking, they do not somewhat justify the habit.

But the answer which the smoker will often give does not embrace all the information that has been acquired. It would be unfair to form an opinion from that answer, and, therefore, I shall next proceed to place before you some other facts regarding the action of tobacco.

I have hitherto spoken of the smoking of tobacco only. You know very well that the indulgence in tobacco includes also the snuffing and chewing of that substance. Snuffing and chewing are not so common habits as smoking, and therefore I will not say anything about them except that both produce the same effects as smoking, although snuffing does so to a much less degree, and chewing to a greater degree than smoking.

When tobacco is smoked, its action is modified by the strength of the tobacco, and by the form in which it is smoked. The strength depends on the quantity of the active substances it contains. These are chiefly an oily substance, which in very small quantity produces sickness and headache; and a liquid, which may be got from the tobacco by distilling it. This liquid, some of you may know, is called nicotine; and it is so strong a poison that it may be likened to prussic acid, and if a small drop of it is given to a dog, the dog will die very quickly. Fortunately, there is only a minute quantity of it in tobacco, as it is impossible to get more than four or five drops from an ounce of strong tobacco. Fortunately, also, when tobacco is burnt, much of the nicotine is also burnt, so that only a minute trace is present in the smoke. A part of it and of the oil, also, adheres to the stem of the pipe, or the end of the cigar; and this explains why it is that a cigar becomes stronger as it is being finished, and why a new clay pipe

is much weaker than an old well-seasoned cutty. The "juice" in an old pipe contains a large quantity of both substances, and it is so poisonous that the greatest care should be taken in keeping such pipes from children.

When tobacco is smoked by a person who is not altogether new to the practice, a great many parts of the body are soon affected.

The brain is a little excited, intellectual work is made more easy and less fatiguing, and any tendency to sleepiness that may exist is removed. In a person accustomed to the use of tobacco, intellectual work is difficult when smoking cannot be indulged in, the mind cannot easily be concentrated on a subject, and unrest is produced—but this disappears when recourse is had to smoking; and probably some of its reputation as a soothing agent has on this account been acquired.

The circulation is also a little excited, and no doubt this assists in rendering brain work more easy. In a short time, however, the circulation is slightly depressed, the pulse becoming smaller; and this may assist in producing the soothing effect generally experienced.

The digestion of food and the nutrition of the body seems also to be affected. Moderate smokers not uncommonly smoke a short time after dinner, the principal meal of the day. The reason for this may be found in the fact that several of the fluids, or secretions —of great value in the digesting of food—are increased by tobacco. The nutrition of the body also is modified by tobacco. A series of experiments similar to those I have spoken of in connection with alcohol have been made by Dr Hammond with tobacco, and they showed that when the food is sufficient in amount, tobacco increases the weight of the body; and when the food is not sufficient, and the body in consequence would lose weight, tobacco restrains the loss.

Now, ladies and gentlemen, I think that in many of these actions, or in the aggregate of them, we can discover the reasons that have led to the prevalence of tobacco smoking, and which

have caused smokers to persevere in the habit, notwithstanding the horrors of a first initiation. To many persons it is undoubtedly a comfort; and, where privation and hardship exist, the comfort is all the more longed for. When hunger and fatigue are being suffered, tobacco undoubtedly affords relief; and where long-continued privation and hardship have been suffered, tobacco is eagerly longed for. The master of a French whaler tells us that, when he rescued eight English sailors, who had subsisted on penguins and shell-fish on a desert island for eighteen months, he offered them whatever was on board his ship; but they did not ask for bread or spirits—they eagerly demanded tobacco, regretting that they had been deprived of its consolatory influence during their protracted misery.

But we cannot stop here. Tobacco, like alcohol and other indulgences, may be, and very frequently is, abused. This abuse inevitably produces injury. And let me now point out what are the injurious consequences of its abuse, and, as far as I can, how they are produced. You may know that there exist anti-tobacco societies and associations, some of which publish the most alarming statements regarding the effects of tobacco, which remind one of the extravagant assertions which were made in the earlier days of its history, such as that it produced a sort of "sooty deposit within the skull-cap or in the brain itself."

The nearest approach to this effect is probably the blackening of the teeth of confirmed smokers, which is undoubtedly a disfigurement that may exert a deterrant influence, especially upon the fair sex.

In confirmed smokers, who occasionally exceed the limits of moderation, there are, however, produced effects which are not only inconvenient, but detrimental to health.

It causes in them disagreeable symptoms in connection with the nervous system, such as headache, sleeplessness, depression of spirits, want of steadiness, with tremors in the arms and legs, and distressing itchiness of the skin, from which they suffer especially when lying awake and unable to sleep in bed.

The circulation of blood becomes affected. They suffer from palpitation and giddiness, the pulse becomes irregular and weak, and the heart does not contract properly. When the pulse is carefully examined it is found that every now and then one of the pulsations is missed out. This change in the circulation causes much anxiety to those in whom it occurs. It is a very common symptom in habitual and excessive smokers. Only a few days ago I saw a gentleman in whom it was very distinctly present, and was accompanied with breathlessness, faintness, and distressing pain in the chest over the heart, shooting from there sometimes to the throat, and sometimes to the arms. He suffered frequently from these attacks, and each time felt as if he were about to die.

I have said that breathlessness is one of the accompaniments of the bad effects of smoking upon the circulation. This is well known to men who are in training for athletic contests, and it is the invariable custom with them to refrain altogether, or almost altogether, from smoking; for they know very well that if they do not refrain they would have a poor chance of winning a race. Now, apart from the bad action upon the circulation of blood, there is very good reason why those who require to keep their "wind" in good condition should not smoke. The smoke of tobacco irritates the back of the throat, and the air tubes which go to the lungs from the throat, and produces there an inflammation which, because it lasts a long time, is called a chronic inflammation. This inflammation thickens the inside lining of the throat and air tubes, and also causes it to be covered with a thick glairy fluid, and, of course, the result is that the tubes are narrowed, and air passes through them less easily than it should. The consequence may be that a form of sore throat is produced, which is sometimes called, "Smoker's sore throat," and you sometimes recognise it in public speakers by the frequent hawking cough with which their eloquence is interrupted.

Inveterate smokers generally suffer also from indigestion. They have poor appetites, and the food they take torments them. When

they rise in the morning they do not anticipate breakfast with any relish, for their tongues are dry, and covered with a grey fur, and they are not hungry, as everyone should be in the early morning. The consequence of the disorder of the digestion is that the body is not properly nourished. The inveterate smoker is pale faced, or has a sallow appearance, and when the blood—the fluid by which the body is immediately nourished—is examined, it is found to be of poor quality. The small red cells and the colouring matter in it, which have been described to you in a previous lecture, are not present in sufficient quantity. In fact, a disease exists which we physicians are in the habit of calling anaemia, and which is always accompanied with inability for work, even when the work is of the lightest description, and also with palpitation, giddiness, and faintings.

Tobacco smoked to excess also injures the sight. It does so directly by the irritating smoke coming in contact with the eyes, and producing inflammation. It does so also, indirectly, by the action of the tobacco on the nervous system. The latter is the most serious injuring, for it produces dimness of vision and even blindness, which is difficult to cure.

Now, all these bad effects to which I have drawn your attention are much more easily produced by smoking in a close, confined room, than in the open, outside air. Those who smoke know very well that they are extremely likely to suffer, even after moderate smoking, if that has been indulged in in a close room, along with a number of companions, who were also smoking. This is to be explained by the air in the room becoming saturated with tobacco smoke, so that the air breathed is not pure air, but air containing smoke from each of the smokers, who are subjected to the advantage or disadvantage of inhaling the smoke emitted by all the smokers. Companionship in smoking within doors is, accordingly, anything but an unmixed advantage. It is a frequent cause of illness in moderate smokers, even when it occurs in a large and not otherwise overcrowded room. It is a much more frequent cause of illness in the confined smoking-carriages of rail-

ways; and its deleterious influence is every day shown in the suburban railways of the larger cities, and I fear will become manifest here, as an evil accompaniment of many advantages, when the proposed suburban lines are in operation. Those who have had occasion to travel in the outskirts of any of the large cities, such as London, or Manchester, or Glasgow, must have been struck by the evil effects which are produced in the crowded smoking carriages, conveying from the outlying towns persons of all classes into the business centres. Persons not only of all classes but also of all ages; and in connection with this let me point out that if excessive or even moderate smoking in a confined atmosphere, is peculiarly injurious, it is especially so to young persons. Smoking to any extent is productive only of injury to the young. This was some years ago recognised in France, where the Minister of Public Instruction forbade the use of tobacco and cigars by the scholars attending the colleges and schools throughout the whole kingdom, on the ground "that the physical as well as the intellectual development of many youths has been checked by the immoderate use of tobacco." The special evils have been carefully investigated by a French writer, Dr Decaisne, who expresses his conviction that whatever doubts may exist regarding the pernicious effects of tobacco-smoking in adults, they are incontestable in children. He found that in the young even its restricted use quickly produces dyspepsia, sluggishness of intelligence, and deterioration of the blood, that disease which I have already described as anaemia. He also found that the anaemia cannot be cured so long as the smoking continues. I need say no more to convince you, that you will do much good if you exert your influence and authority to prevent children and youths from smoking; and you will perhaps sympathise with me when I express the opinion that the habit is far too often observed among boys on our streets, and that good would be done by the exercise of deterrant discipline, not only by parents, but also by the municipal authorities.

It would appear also that women are, like young persons, spe-

cially susceptible to the bad effects of tobacco. I need not, however, dwell on this susceptibility. The women of this country are not addicted either to its use or abuse. A short, well-seasoned cutty pipe may, now and then, be seen in the mouth of a female inhabitant of the Cowgate or of the Canongate ; but I have generally found, on inquiry, that that inhabitant was not a *native*, but an immigrant from the sister isle.

Such, then, are the pernicious effects of tobacco, and every moderate smoker is liable to suffer from them. Whenever any of them occurs, the moderate smoker will consult his own interest if he either at once ceases his indulgence, or greatly reduces it ; for although most of the bad effects quickly disappear if the immoderation ceases—and in this respect contrast most favourably with the bad effects of immoderation in alcohol—during their continuance they injure health, and interfere greatly with the performance of work.

Some persons are unable to tolerate the smallest quantity of tobacco, and smoking produces only bad effects upon them. Others escape any injury, and consider that they are even benefited by tobacco. They escape injury because they are able to exercise self-control, and so ensure moderation. Such men may attain a ripe age, though few can hope to be so successful in this respect as the famous Dr Parr, who indulged in tobacco to an extent that would for most persons constitute immoderation, and nevertheless lived until he was seventy-eight years of age. The majority of moderate smokers can, however, rarely avoid occasional or frequent immoderation ; and as the years pass, the evil effects of each excess would appear to accumulate, or the tolerant powers of the body to diminish. In my experience this has often manifested itself in moderate smokers about their fortieth year of age ; and if they are wise, they then cease, or greatly lessen their smoking.

APPENDIX.

THE USE AND ABUSE OF ALCOHOLIC STIMULANTS AND TOBACCO.

Although the proper *use* of alcoholic stimulants and of tobacco may be productive of some good, their *abuse* must be placed among the chief vices of the present time.

Alcoholic Stimulants are such beverages as whisky, brandy, gin, wine, porter, and beer. They all contain "spirit." This spirit is alcohol. When it is mixed with a little water, it is called "spirit of wine;" and when it is mixed with about an equal quantity of water, and some flavouring, colouring, and sweetening substances, it constitutes the "spirits" whisky, brandy, gin, and rum. The other alcoholic stimulants contain less alcohol and more water than whisky. In small quantities, alcoholic stimulants improve digestion, and increase the quantity of blood sent to the surface and to many of the organs of the body. In this way, they may do some good to persons who have weak digestion, and to persons who are exhausted or suffering from fatigue; but in weak digestion, a carefully arranged diet and proper medicines, and in fatigue, warm tea or coffee, or beef tea, are much more valuable, and much less dangerous than alcoholic stimulants.

When the quantity of blood at the surface of the body or in the stomach is increased by alcoholic stimulants, the person *feels* warmer, but is really very little if at all warmer; while the mere fact of the surface blood-vessels containing more blood than they should, hastens the cooling of the body, because the surrounding air is always colder than the blood. These stimulants, therefore, do not heat, but make colder any one who takes them on a cold day, and they make one less able to withstand the bad effects of exposure to cold. When the quan-

tity of blood sent to the brain is increased, brain-work seems to be made easier, but nearly always the quality of the work is deteriorated.

Alcoholic stimulants can help in nourishing the body by acting as food. When, however, they are used along with a sufficient, and much more, with a too large quantity of food, they in a short time produce dyspepsia, excited circulation, indisposition for work, and other undesirable effects. They are, besides, very expensive foods, and it has been proved that men can do continuous hard work better without than with them. In children, they are particularly hurtful, because they interfere with the growth of the body, and accustom them to what is very often productive of after misery.

When frequently taken in rather large, or even moderate quantities, they produce a great many diseases, by making important organs and parts of the body unhealthy, such as the stomach, liver, kidneys, brain, and blood-vessels. For this reason, the immoderate consumption of alcohol very decidedly shortens life.

In large quantity, they produce also intoxication, which is not only in itself a degradation, but also the cause of much crime and misery. A single very large quantity is strongly poisonous, and may kill in a short time.

Tobacco is made from the leaf of an American plant called *Nicotianum Tabacum.* It was first used in this country in the 16th century, and is now very largely used in every known country throughout the world. It is used by smoking, chewing, or snuffing. Snuffing causes the weakest effects, chewing the strongest, and smoking effects intermediate between the two.

The smoking of two or three pipes has been sufficient to kill a person unaccustomed to tobacco, while the smoking of seventeen or eighteen pipes continuously, has killed a person accustomed to tobacco.

The effects of tobacco depend on an oily substance and a very poisonous liquid, nicotine, which are present in the leaves; and when tobacco is smoked, they enter the mouth along with some other substances produced by the burning.

Moderate smokers find that smoking soothes them when they are excited, refreshes them when they are fatigued, and helps them to digest food, to do brain-work, and to bear hunger and privation.

Excessive smoking, and even occasional immoderation, are hurtful to the nervous system, the circulation, the respiration, the digestion, the eyes, and the nutrition of the body.

Injury to the *nervous system* is shown by the production of headache, sleeplessness, depression of spirits, and want of steadiness, along with tremors in the arms and legs.

Injury to the *circulation* is shown by the production of palpitation, giddiness, and irregularity and weakness of the pulse.

Injury to the *respiration* is shown by the production of breathlessness, bad "wind," and "smoker's sore throat."

Injury to the *digestion* is shown by the production of loss of appetite, heartburn, sickness, and a foul tongue.

Injury to the *eyes* is shown by the production of sore or inflamed eyes, and, sometimes, of blindness.

Injury to the *nutrition of the body* is shown by the production of paleness or sallowness of the face, and a bad quality of the blood, which is called anæmia.

All of these bad effects are intensified when the smoking takes place in a confined room, or in a railway carriage, in which several persons are smoking. The air then becomes very rapidly impure ; and, further, each smoker breathes in some of the smoke from the pipes or cigars of his companions, in addition to what he breathes in from his own pipe or cigar.

Smoking to any extent is productive only of injury to young people. It checks their physical and mental growth ; and is more likely to produce in them a bad quality of the blood than even in adults. Children and youths should be prevented from smoking by those who have authority over them.

Nearly all regular smokers become more easily injured by tobacco as they grow older. After the age of 40, they are very likely to suffer from indigestion, palpitation, and giddiness, and they should then either greatly diminish their smoking or altogether stop i+

PREVENTABLE DISEASES AND THEIR CAUSES.

BY DR SMART.

ON the Evening of Saturday, 5th February 1881, Dr Smart delivered the tenth and concluding lecture of the Course of Health Lectures in the Free Assembly Hall, his subject being "Preventable Diseases and their Causes." Dr Smart said :—

LADIES AND GENTLEMEN—

The title of this lecture is "Preventable Diseases and their Causes," and I have chosen it to indicate as nearly as possible the nature of the subject I have to speak of. Under this title we include, for the present, only such as come under the head of Zymotics—that group of diseases, viz.: which are more directly affected by public measures of prevention, and by the conditions which affect large communities. Many other diseases which are, strictly speaking, preventable, such as arise from noxious trades and unhealthy occupations, are not here included, but will, I trust, at some future time, form the subject of an interesting and useful lecture to you. A preventable disease may be described as one which arises or spreads in consequence of the wilful, careless, or ignorant violation of those laws, the proper observance of which we know to be necessary to insure the preservation of health, and avert the spread of disease.* Those diseases—a very numerous group—which result from personal vices or from depraved habits of the community, are beyond the immediate control of public measures.

The chief of the zymotic diseases are :—smallpox; typhus fever; typhoid (or enteric fever); scarlet fever (or scarlatina); diphtheria; measles; and Asiatic cholera. We will consider them

* Grimshaw.

from the following points of view: *first*, the injury they inflict; *secondly*, how they originate; *thirdly*, their distinctive characters; *fourthly*, the conditions under which they spread; and *fifthly*, the means necessary for their control and prevention. "It seems certain," writes Mr Simon, Medical Officer to the Privy Council, "that the deaths which occur in this country are fully a third more numerous than they would be if our existing knowledge of the chief causes of disease were reasonably applied throughout the country; that of deaths which, in this sense, may be called preventable, the average yearly number in England and Wales is about 120,000, and that of the 120,000 cases of preventable suffering which thus in every year attain their final place in the death register, each unit represents a larger or smaller group of other cases, in which preventable disease not ending in death, though often of far-reaching ill effects on life has been suffered. . . . Then there is the fact that this terrible continuing tax on human life and welfare, falls with immense over-proportion upon the most helpless classes of the community; upon the poor; the ignorant; the subordinate; the immature; upon classes which, in great part through want of knowledge, and in great part because of their dependent position, cannot remonstrate for themselves against the miseries thus brought upon them. And have, in this circumstance, the strongest claim of all claims on a legislature which can justly measure and can abate their sufferings."*

"Diseases of this class," says Dr Farr, the Registrar-General, "distinguish one country from another, one year from another. They have formed epochs in chronology; and, as Niebuhr has shown, have influenced not only the fates of cities such as Athens and Florence, but of empires; they decimate armies, disable fleets; they take the lives of criminals that justice has not condemned. They redouble the dangers of crowded hospitals; they infest the habitations of the poor, and strike the artizan in his strength down from comfort into helpless poverty; they carry away the infant from the mother's breast, and the old

* 13th report of the Medical Officer of the Privy Council.

man at the end of life; but their direct eruptions are excessively fatal to men in the prime and vigour of age." These weighty words of the two greatest living authorities on this subject ought to be well pondered.

Mr Simon reckons the deaths from these diseases at 120,000 in England and Wales alone. If we add those in Scotland and Ireland, from the same causes, the total mortality is over 150,000, every one of which is a needless death. Does this not strike you as a frightful waste of life? If we now compute that each one of these deaths represents, at a moderate estimate, thirty instances in which there is loss of health short of death, the aggregate of needless death aud suffering becomes perfectly astounding, and affords a sufficiently cogent reason why zymotic diseases are specially singled out to be dealt with by stringent enactments having for their object their prevention, and ultimately total extinction.

THE GERM THEORY OF INFECTIOUS DISEASES.

How they Originate.—The term Zymotic is applied by those who believe that in these disorders there takes place a process which bears a striking resemblance to that of fermentation. This resemblance was first pointed out by Leibig. Thus, when yeast is added to a solution of sugar, the yeast cells rapidly multiply by feeding on it—alcohol and carbonic acid being given off during the process. Yeast, I should tell you, is a rudimentary plant composed of cells, which, when placed in a suitable medium, actively multiply, living at the expense of the medium in which they exist, and ultimately changing its character. (See Diagram.) This is fermentation, as it occurs outside of living bodies, and is the starting-point of the idea that germs of different kinds—animal and vegetable—are the active agents in the production of zymotic diseases. That these germs *do* exist abundantly in the air, and elsewhere, has been proved by the experiments of many observers, and especially by Pasteur, a French physiologist. [Here describe and show Pasteur's experiments with air and liquids in sealed flasks.]

Pasteur found by experiment that certain changes which sometimes take place in beers and wines, during the course of preparation for use, and which he calls "diseases," are owing to the presence of vegetable germs, every particular change being due to a different kind of germ. Another investigation, which he undertook at the earnest entreaties of his friend and preceptor Dumas, the celebrated chemist, resulted in a discovery which throws interesting light on the same subject, by showing how animal germs may be the cause of a disease among animals of a very destructive and infectious kind. France, a few years ago, was threatened with a great calamity. For fifteen years a plague had raged among its silkworms. In 1852 the silk culture of France yielded a revenue of 160,000,000 of francs; ten years later it had fallen to 4,000,000. Pasteur found that the bodies of the silkworms which had the disease were infected by minute corpuscles, which, taking possession of the intestinal canal, spread thence throughout the body. They filled the silk cavities, the stricken insect often going through the motions of spinning without any material to answer to the act. The organs, instead of being filled with the viscous liquid of the silk, were packed to distention by these corpuscles. On this feature of the plague Pasteur fixed his whole attention, and brought the inquiry to a triumphant issue! By inoculating the healthy worms with the corpusculous matter, he found the disease to be highly infectious. He further showed how the silkworms infected one another by inflicting wounds upon each other by means of their claws. He washed the claws, and found the infecting corpuscles in the water. He next spread the infection by simply bringing the healthy and diseased into contact. The diseased worms sullied the leaves of the mulberry tree among which they spin, and by their dejections spread infection in both ways.*

These observations exemplify in the most striking manner what actually takes place in some of our own zymotic diseases.

Whatever be the difference of opinion as to the precise nature

* (Tyndall—"Dust and Disease.")

of the infecting elements in these diseases, whether they be the rudimentary forms of animal or vegetable life, or merely particles of our own bodies which have acquired a poisonous property which does not naturally belong to them, most are now agreed, I think, that such particles have a veritable existence.

With the limited time at my disposal, I can but give you the briefest account of the proofs that have recently been accumulating in support of Pasteur's views, besides those of many other observers,* that *that* something by means of which infecting diseases pass from one to another, has a real existence, is an organised solid, however minute, which is the absolutely indispensable agent in the transmissibility of these diseases. These opinions mark a great advance in the medical views of the past few years. The phantom of what used to be called an "epidemic constitution of the atmosphere" has ceased to haunt us, while sanitary and medical science are more and more mustering their resources for the utter destruction of those invisible potentialities which are everywhere about us, "both when we sleep and when we wake." Let me illustrate what I have said by means of these diagrams. You see those particles; they are so minute as to require the aid of a powerfully magnifying lens to bring them into view. They are obtained by filtration from vaccine lymph, which appears to our unassisted eye to be a clear fluid. If the lymph without the particles be used to vaccinate, it entirely fails; but if the particles be used without the fluid, it perfectly succeeds. You will better understand what I mean when I tell you that a person undergoing vaccination, is passing through a mild or modified form of small-pox. These particles may be therefore regarded as the virtual agents in the production of small-pox. Similar particles perfectly alike in outward form exist in the lymph of Glanders or Farcy, a most virulent disease which attacks horses, but is communicable to man. A horse inoculated with the fluid, without the particles, would escape, but not if it contained the particles.

In this other diagram you have a view of infecting germs derived

* Obermeyer, Klebs, Chaveau, Burdon Sanderson, Lister, Greenfield.

from the vegetable kingdom (Bacillus anthracis), namely, the rod-like fungus of anthrax, a fatal disease, chiefly attacking animals such as the horse and ox, and sometimes man. These infecting particles resemble, as you see, minute rods. They grow into fibres, then fructify, each one producing a number of spores, which are the oval bodies seen in the diagram. In this disease, these germs infest the tissues and blood of the infected animal or person, and live, grow, and multiply at the expense of the tissues and blood. If now the blood containing these rods and spores be filtered, it becomes harmless, that is, it will not infect another animal. But, on the contrary, these bodies will cause the disease in its most virulent form.

This diagram shows a drawing of a section of skin in erysipelas, an infectious disease of a rapidly spreading nature, characterised by great inflammatory swelling and redness (hence named St Anthony's fire). The dotted portions indicate the lymph vessels and spaces, the dots representing minute vegetable spores (micrococci) crowding the spaces. There is no longer any doubt that diphtheria is a disease essentially due to the presence of similar parasitic organisms.

This other diagram furnishes an example of another kind. It exhibits the spirilla of relapsing fever,* sometimes called famine fever, from its occurrence during periods of scarcity. You readily distinguish the organism existing among the blood-corpuscles by its spiral or corkscrew appearance. This fever relapses for a week, then suddenly re-appears for a week, and so on, hence its name. The spirilla is found in the blood when the fever comes on, and disappears when it goes off, and finally disappears, when the sufferer recovers—thus proving its connection with the disease.

Another discovery has lately been made by Professor Klebs throwing much interesting light on the causation of marsh or malarial fever. He found a species of vegetable organism existing in the air of the Pontine marshes, which, when injected under the skin, produced that fever. Further proof of the connection

* Obermeyer.

of these organisms with malarial fever is found in the fact that they are present in the organs, and in the blood of persons who die of marsh fever.

I found rod-like germs abundantly present in the blood of animals attacked with cattle plague, one of the most intensely infectious diseases that ever visited this country. They are delineated in my reports on the subject to the Authorities. So far as I am aware, it was the first time that they were shown to exist in the blood of living animals.* A few facts will better enable you to comprehend the enormous fertility of germs and spores.

Among the larger animal germs, which are visible to the naked eye, and may therefore be counted, the late Mr Buckland found no fewer than seven millions of eggs in a single cod-fish. The Ascaris, an intestinal worm infesting man and other animals, produces about sixty-four millions of eggs; and in the vegetable kingdom some single plants yield over seventy-four millions of seeds in a season. Numerically great as these figures are, they are dwarfed by the greater productiveness of the spores of some fungus plants. They are inconceivably minute—two hundred millions, side by side, would not cover a square inch—yet they possess an inherent vitality, which, under favourable circumstances, will burst into life, reproducing the parent plant from which they sprung. Again, we are told that spores, equal in number to the entire inhabitants of the globe, placed side by side, may easily rest on a space four inches square; and that one million would find ample accommodation on the head of a pin!

Professor Tyndall was the first, I think, to make these facts, viz., the presence of particles in the air, palpable to our senses by an experiment which you can all make for yourselves. He let a sunbeam into a darkened room, through a chink or hole in the shutter. The bright ray revealed the floating dust—for it is a fact that without dust there would be no visible ray. It is the particles of dust that intercept and scatter the light and make it visible to us. A similar effect is produced when

* September, 1865.

a bright ray, for example, from the electric light, or lime light, is thrown across a darkened room. When the flame of a spirit-lamp is then placed under this ray it gives the appearance of smoke passing through it, but there is no smoke from the spirit-lamp, and the black space is produced by the heat of the lamp burning the particles floating in the luminous beam, and for the time being rendering that part void, or empty of particles. The black spot thus produced is said in scientific phrase to be "optically empty."

The experiment may be turned to practical and really useful account, by showing us that these particles may be prevented from entering the lungs. Thus, a handful of cotton is placed against the mouth and nostrils, and a full breath inhaled through it, which is easily done. The cotton is now removed, and the air in the lungs made to pass through a glass tube into the luminous ray, when a dark smoke-like space is seen, as in the previous experiment with the spirit-lamp. This shows that the air is filtered of its particles by passing through the cotton.

DISTINCTIVE CHARACTERS OF INFECTIOUS DISEASES.

Accepting, as we do, the theory that each case of infectious disease originates in the reception of a distinctly specific, pre-existing poison, and that it in turn becomes self-propagating, we now go on to speak a little in detail of each of these zymotics. There are some features which are common to the whole group. They all, for example, begin with a period of what is called "dormancy" or "latency" or "incubation," during which the poison is actively developing. But the duration of this period differs in each case. That of smallpox is twelve days; typhus fever, eight to fourteen days; typhoid fever, fourteen to twenty-one days; scarlet fever, three to six days; measles, about four days. These differences in the length of the incubation period being probably due in each case to the amount and strength of the poison received. At the termination of this period, the sickness is said to begin, although its distinctive character may not appear for some days longer. These fevers

are all ushered in by a marked, and sometimes sudden, elevation of bodily temperature, which, with variations, continues during the course of the illness. It is because of this increased temperature that they are called fevers. Characteristic eruptions now appear. Scarlatina on the second, measles on the fourth, and smallpox on the third day, and so on. Now begins the infecting period, which increases with the activity of the disease.

SMALLPOX.—The patient is now charging the air, and everything about him, with a most subtle and deadly virus, derived chiefly from the skin and mucous membranes, but not restricted to them. There is no contagion so strong and sure, or that operates at so great a distance, passing from house to house, from street to street, making sanitary precautions difficult. I regret to add that cases of this disease, imported from London, are already here.

TYPHUS FEVER once contracted is highly infectious, and essentially a disease of over-crowding and foul air from deficient ventilation, associated with squalor and want, and a deteriorated constitution from whatever cause. It chiefly infects by exhalations from the skin and lungs. The patient's bedding and clothes become saturated, and the poison clings so persistently to the walls, and to everything in the room, as to make the destruction of the latter in many cases necessary.

TYPHOID FEVER differs from the preceding in its being but slightly, if at all, infectious through the air. Here the seat of the attack is the intestinal canal chiefly, and the poison is mainly eliminated by that channel. It is accordingly the intestinal discharges, and clothes or bedding tainted with them, that have to be mainly looked to, and every precaution taken by disinfection and removal, to prevent their access to water sources, such as wells, or into house drains; where, by decomposing, they infect by their effluvia. These discharges acquire their maximum infective power when decomposing.

ASIATIC CHOLERA.—We are fortunate in this country in being rarely visited by this Oriental epidemic. The precautions are the same as in typhoid fever—the source of danger being alike in both cases. It is astonishing how small a quantity of intestinal discharge in these disorders, especially in cholera, will taint the water supply over a large area, which may mean death to thousands. Dr Farr estimates that in cholera, if these fluid discharges contain infecting particles in the same proportion as blood corpuscles exist in healthy blood, forty-two millions of them would be set adrift during the progress of a single case.

SCARLET FEVER.—There is perhaps not any other illness that you are all more painfully familiar with than this fever. It is a household experience, a troublesome one, which is regarded very much as inevitable.

Although no age is exempt, it is essentially a children's illness —attacking mostly between the ages of three and four, and the risk lessens after the fifth year. Its poison is most active and penetrating, and retains the power of infecting for indefinitely lengthened periods. As nearly all the fluids and tissues participate in the attack, they may all infect,—the skin by casting its outer surface, the internal membranes by a like process, tainting the secretions. Isolation, that is separation, is a necessary part in the treatment of this fever. The worst cases are associated with malignant sore-throat, which so far brings it into relation with another very infectious malady, viz., DIPHTHERIA, the seat of which is chiefly the throat and upper air passages, and the infecting channels, the breath and expectoration. I have said that these disorders are all marked by increased bodily heat. This is, however, but one of the many symptoms which signalizes their course. In most the heart's beats are doubled; the blood courses along the vessels with redoubled velocity; the respirations are doubled. The whole vital machinery is working under its highest possible pressure. Bodily waste is more than doubled. In ordinary health our bodily substance breaks up, and is parted with

at an expenditure equal to several pounds' weight per day; but during the febrile state health limits are vastly exceeded.

I leave you to draw your own conclusions as to the consequences which must follow to others, when this enormous amount of infective material is daily set adrift—for we must remember that our waste and *effete* materials, under these conditions, become charged with the virus of the disease!

I wish now to say a few words on what has been fittingly named—

THE BREEDING PLACES OF INFECTIOUS DISEASES.

For this purpose I select some of those localities from which these diseases are never altogether absent, and from which they usually go forth upon the rest of the community. Examine with me for a little these diagrams:—Of these six columns, the shortest represents the healthiest district, the tallest the unhealthiest, showing the extreme of six districts existing in different parts of a neighbouring city. The upper portion of each column represents the number of deaths from the infectious diseases which occur in each of these districts; the middle portion, the number of deaths resulting from pulmonary diseases, mostly consumptive; the lower portion, the deaths from what is called "unclassified" diseases. Now, notice that the rate of deaths steadily increases; thus, in the district represented by the shortest column, the inhabitants are aggregated together in the proportion of thirty-five persons to every acre of it, and its death-rate is nineteen persons per thousand annually. In the next they are aggregated together in the proportion of four hundred and twenty-six persons to every acre; and its death-rate is thirty-five persons per thousand annually. In the third, their aggregation is in the proportion of four hundred and fifty per acre, with a death-rate of thirty-eight per thousand. The fourth, the proportion is three hundred and fifty per acre, and the death-rate forty-one per thousand. The fifth is, three hundred and fifteen per acre, and a death-rate of

forty-three per thousand; and, sixthly, in the highest column, they are aggregated together in the proportion of five hundred and eighteen, with the death-rate of forty-five per thousand. The fourth and fifth are only *apparent* exceptions to the rule of an increasing death-rate with an increasing density of population. The inhabitants of these districts, although fewer, are more densely huddled together.

Look now, for a moment, at the composition of each of these columns, and you will observe that the death-rate from infectious diseases, not only steadily increases with the density of its population, but also that from pulmonary and "unclassified" diseases. These groups are represented in different colours, and will assist you to form a juster conception of the dangers resulting from over-crowding.

The credit of working out, and applying this important law of death-rate to density, belongs to Dr Farr.

Taking the five hundred and ninety-three registration districts into which England and Wales (not including London) are divided, he arranges them into so many groups according to their densities, beginning with the most thinly populated rural district, with only a hundred and sixty persons to the square mile, and ending with the most densely packed town districts, as Glasgow and Liverpool, with over sixty thousand on each square mile. Let us now, with the assistance of these other diagrams, note the results.

In the district	with	166 on each square mile	there is a	death-rate of	17 p. 1000
,,	,,	379 ,, ,,	,,	,,	22 ,,
,,	,,	1718 ,, ,,	,,	,,	25 ,,
,,	,,	4499 ,, ,,	,,	,,	28 ,,
,,	,,	12,357 (Manchester)	,,	,,	38 ,,
,,	,,	66,000 (Liverpool)	,,	,,	39 ,,

Glasgow, with a density of population nearly similar to that of Liverpool, has a much lower death-rate, thanks to the enlightened exertions of its able health officer.

How comes it then, that persons living in thinly-peopled rural districts (165 to the square mile), die annually in the proportion

of 17 per 1000, while those of Liverpool perish in the proportion of 39 per 1000? What is the cause of this greatly increased mortality? I cannot answer this question better than by quoting the words of the accomplished Medical Officer of Glasgow, Dr Russell, to whom I have just referred: "Density," he remarks, "means, in relation to Glasgow, that three-fourths of those human beings live in houses of one and two apartments, that those houses are built in tall tenements, so arranged on the earth's surface as to exclude the sunlight and impede the circulation of the air, more especially that a large proportion of those tenements are arranged in hollow squares. . . . It means that inside those boxes there are ash-pits, . . . that planted among those ash-pits we have hundreds of 'back lands,' along with stables, byres, bake-houses, work-shops, washing-houses, and other smoke and effluvia producing erections, that the stairs are often close and badly ventilated, that they are at best vertical streets, with lanes and alleys branching off at the several landings. . . . It means that hundreds of factory chimneys and thousands of domestic vents, maintain over all this devoted area a dense canopy of smoke, which in summer cuts off a large proportion of the sun's rays, an extra supply of whose decomposing energy ought if possible to be secured to aid in the destruction of the organic particles which are so rife in the air of cities, and which, in the winter, descend upon us with the watery vapour of our fogs. . . . Our rivers and streams are loaded with the foulest refuse, that the subsoil is traversed by a net-work of sewers, drains, and gas-pipes, and is therefore so impure that the ground air is loaded with noxious effluvia, and the ground water is so foul that to drink it would be poisonous, if, indeed, it could be done.

"Finally, it means that for grassy fields we have stony streets, and in place of trees we have lamp-posts, and altogether we are as far shut out from the ministry of nature as the necessities of the case, combined with the aggravations of human ignorance, perversity, and wilful self-aggrandisement, can place us."

We have now to speak of

THE CONDITIONS UNDER WHICH INFECTIOUS DISEASES SPREAD.

The Carriers of the Infection.—We have seen how readily infecting germs may be dispersed, wafted by the air, carried by water, tainting our clothes, our money, and the commodities given in exchange for it. The mutual dependence of class upon class, and their unavoidable concourse, the relationships of life, as well as its vicissitudes and necessities, all tend to bring people together—in short, the entire machinery of society such as we find it, is peculiarly adapted to spread infectious diseases.

There can be little doubt that the spreading of these diseases, in the majority of cases, is brought about by the healthy coming into contact with the sick or convalescent. Children after an attack, are allowed to go back to school too soon, and the result is renewed outbreaks of scarlatina, measles, and whooping-cough. The laundress disseminates the poison of scarlatina and smallpox amongst her employers; nurses carry it from sick-beds to their own homes; the tailor and dressmaker often ply their needles close to fever-stricken patients. One doctor writes that he has seen the garments, which were thus being made at their homes, used to eke out the scanty bed-covering of a fever patient; another, that he received a patient into hospital with smallpox pustules on him, who had on the previous day been occupied in dressing ladies' hair. I myself lately entered a house of one room with eight occupants, five of whom were laid down with scarlatina. In the midst of this, the father, an enfeebled man, was trying to earn a little money by working at a couch which ere many days would too surely carry disease into some household. These persons have our deepest sympathy, and if we speak of their hard necessities, it is in the hope, and with the earnest wish that we may be able to mitigate, or remove them.

Let us vary the illustration by another example. The milk-cans, we shall suppose, at a farm-dairy have been unwittingly

washed with water contaminated with sewage; or, perhaps, a little of that element has been added to improve its quality!—then follows what is significantly called "the trail of the milk-man"—a trail marked by fever cases in perhaps every house to which the milk has been distributed.

Or there is a fever at one of our town dairies, in the back-room of the shop, for example, and the attendant on the sick also attends to the customers, who carry the milk to their homes, and with it the germs of future disease. This diagram will assist you to realise more vividly what I have just said. It represents a farm-house in which typhoid fever has arisen, by the milk becoming tainted in the way I have spoken of. This dot marks the first case which arose in consequence.

Observe how the disease spreads from this starting-point. This other dot shows the second case, which arose in nineteen days from the first, and this, the third, in twenty-six days from the first—all in the same house; but in fourteen days from the first case, a group of three cases occurred in a family, supplied with milk from this farm, and within eight weeks from the first case, a hundred and sixty-six persons were laid down with the fever.

Look now at this diagram, illustrating the growth of an epidemic of scarlet fever, from a single case.

It is a moderate estimate of the rate of progression of this fever, to say that each case produces two others. Follow these dots from the starting case, and in seven weeks from its commencement, you will see that the one case has multiplied into two hundred and fifty-six. Once more, study with me this diagram marked cholera. I have said that this disease is propagated by water, fouled by choleraic discharges. Estimating that each case produces five others, a ratio which may be taken as considerably under its usual rate of progression, there would arise six hundred and twenty-five cases within eight days. Several instances of this actually occurred during the cholera epidemic of 1866.

The presence of an epidemic of small-pox in London, and the certainty of its early advent amongst ourselves, lead me to

invite your very special attention to this other series of diagrams, which exhibit in the most convincing and instructive manner, the influence of vaccination in preventing and modifying that disease under different conditions and periods of life. They show the results, based upon a most painstaking and successful investigation, of a thousand cases of small-pox, treated in hospital during 1871, by Dr J. B. Russell. The diagram, as you observe, is divided into large squares, each being subdivided into one hundred smaller squares, so that each large square represents one hundred cases of small-pox. The colouring again, whether black, red, or white, tells you the degree of severity with which each case was affected. Those portions of the squares in *white*, show how many were attacked with the mildest, or *seldom fatal form of the disease* (with rare or sparse eruption). Those in *red* indicate intermediate, or *frequently fatal conditions of the disease* (copious eruption); while the *black* marks the dangerous, or *very fatal type of the malady* (confluent eruption).

The upper row of squares, from left to right, shows the effects of vaccination—between the periods of infancy and adult life—when *well done*; the corresponding middle row, its effects when *badly done*; and the lowest row, when *not done at all.*

By glancing at the diagrams in this order, you will at once observe, that the well-vaccinated, as they grow older, take the disease in a slightly severer form; the badly vaccinated in a much more severe form; and those who have not been vaccinated at all, are *throughout their whole lives*—from infancy upwards—subjected to the very worst and most fatal form of the disease. In other words, you will not fail to draw the inevitable conclusion, "that the influence of vaccination, well and thoroughly done, extends, with but little loss of protecting power, throughout life; while, if badly or imperfectly done, it is never so efficient a protective power, gradually loses what protecting power it had possessed, and finally leaves the badly-vaccinated individual

only a little less susceptible than he who has never been vaccinated at all." *

Each of these infectious fevers grows and spreads by conditions peculiar to itself, which depend, to a considerable extent, on the length of its incubation period.

The two first of these diagrams show sufficiently well the manner in which the recent epidemics in Edinburgh of typhus, typhoid, and scarlet fevers began, and spread; as also nearly the numbers affected, and the duration of the epidemics.

We have now to speak of

THE MEANS NECESSARY FOR THE CONTROL AND PREVENTION OF INFECTIOUS DISEASES.

The instructions intended for your guidance in emergencies which I have drawn up, based on my lecture,† are, I understand, already in your hands; and I am thus so far relieved from many details, which it would otherwise have been desirable for me to touch upon. I will ask you then to hold that part of my lecture as read; and I will now proceed in a few brief sentences to enumerate those measures for the effectual control and prevention of epidemic disease which I consider to be necessary.

Firstly, We must aim at the promotion of cleanliness of every description, by the employment of those legal powers contained in public health enactments, which are amply sufficient for the purpose if carried out.

Secondly, At placing all building operations—such as the construction of houses, selection of healthy sites, house and general drainage—under strict sanitary inspection and supervision.

Thirdly, At preventing over-crowding, alike in dwellings or in districts. This measure comprehends the constant inspection of houses, the width of streets, the height of houses, the removal of old and insanitary dwellings, the promotion of open spaces,

* Lectures on the "Prevention and Control of Infectious Diseases," by Dr J. B. Russell.

† See Appendix.

and the opening up of thoroughfares through dense and insanitary neighbourhoods. Thanks to the efforts of our late Lord Provost Chambers, a good beginning has been made in this direction in this city.

Fourthly, It will be found utterly impossible to prevent infectious diseases without a more stringent act in regard to their registration. *Nothing short of the compulsory registration of these diseases will effect this end.* To prevent their spread it is essential that the authorities should be early apprised of the existence of every case.

Fifthly, Following from this the authorities should be entrusted with the discretionary power of compulsory removal. This power will never be abused; and,

Sixthly,—Such powers imply, and, indeed, necessitate, on their part, the providing of ample accommodation for the reception of infectious diseases, as will suffice to meet the emergencies of epidemics; for the reception of actual cases, convalescent cases, suspected cases; and further, for the reception of patients who may voluntarily desire to be treated in hospital. There are many such, who, though comfortably circumstanced in their own homes, would gladly avail themselves of this provision. It may interest you to know that the late Sir James Simpson expressed his determination to be treated in hospital in the event of his suffering from an infectious illness. All such arrangements would require to be carried out in a liberal interpretation of the acts. For example, the greatest difficulty is experienced in the removal of children, from the unwillingness—a natural one—of mothers to be parted from them during their illness.

Mothers, under certain restrictions, should be admitted to the hospital to nurse their own children.

It is proposed to acquire the ground and buildings of the old Royal Infirmary as a hospital of this kind, under the entire control of the civic authorities. This is a step in the right direction.

We enjoy the services of an able and energetic medical officer, whose heart is in his work—but without such powers and provi-

sions as I have indicated, the best efforts of the authorities and of their medical officer will fail of their object.

I have only, in conclusion, to add that it is most desirable to have our people thoroughly informed in regard to sanitary matters, in order that they may heartily and intelligently assist in promoting what is really necessary for their own and their neighbours' good.

To further this desirable movement has been, I know, the cherished object of the promoter of these "Health Lectures for the People."

At the close of the lecture Dr Smart showed Professor Tyndall's experiments by means of the lime-light.

APPENDIX.

ON PREVENTABLE DISEASES AND THEIR CAUSES.

GENERAL PRECAUTIONS.

1. The following preventable diseases (called also zymotic) are all *infectious.* The chief of these are :—Scarlet fever, typhoid (or enteric fever), typhus fever, smallpox, measles, diphtheria, whooping-cough, and Asiatic cholera.

2. When any of these illnesses (except whooping-cough) enters a household, the patient should be, if possible, at once separated from the rest of the inmates (especially from the bread-winners); the children who are in health kept from school, and as much as possible from mixing with other children.

3. The sick-room to be divested as much as possible of every article of needless furniture, especially of woollen fabrics, such as carpets, curtains, cushions, &c.; to be well ventilated by means of a fire constantly burning, and the strictest cleanliness observed.

4. A large vessel (a tub) to be kept in the room, containing a couple of gallons of water mixed with carbolic acid, in the proportion of one wine-glassful of the liquid acid to each gallon of water. Into this, every article of clothing, bed-clothes, &c., removed from the patient, should be immediately plunged, and kept there for twelve hours, and then washed apart.

5. A basin containing water, having two tablespoonfuls of Condy's Fluid added to it, to be always in readiness for cleansing the attendant's hands, or sponging the patient when necessary. This solution should be renewed when it is seen to lose its bright purple colour.

6. A sheet dipped in the carbolic solution named, should be hung over the door of the sick-room, reaching to the ground, and kept constantly damp by means of sprinkling or a sponge. Only the attendant to enter the sick-room.

7. The dress of the attendant should be of cotton, or of some washable material, with smooth surface.

8. Food that has been in the sick-room, on no account to be used by the other inmates. It is desirable for many reasons, that the attendant do not take her meals in the sick-room.

9. Dishes, and vessels of every kind used about the patient, ought to be thoroughly cleansed before being used by others.

10. *All* discharges from the sick to be received into vessels containing disinfectants (Calvert's or Macdougall's Carbolic Powder), and, if convenient, deposited in the ground to the depth of about two feet. If disposed of by w.-c., it should afterwards be freely flushed with the carbolic solution.

SPECIAL PRECAUTIONS.

SCARLET FEVER.

11. To prevent infection by the particles which peel off from the skin, the patient should be anointed once a-day with carbolic oil, made with one part of carbolic acid, to fifty of olive oil. The efflorescence (or peeling off) is first seen on the skin of neck and arms, and begins sometimes as early as the fourth day. The anointing should be complete, including the head, the oil being freely applied to the roots of the hair. This should be continued for six weeks, a warm bath being given weekly during that time. After this period (six weeks), the patient may mix with the other members of the family; but children should not return to school for two weeks longer.

MEASLES.

12. The same rules as above to be observed, with the addition that the discharges from the mouth and nostrils should be received on cloths which may be destroyed by burning.

TYPHOID FEVER.

13. The poison by which this fever spreads is chiefly contained in discharges from the bowels. These may infect the air of the sick-room, the bed, and body-linen of the patient, and the w.-c. and drains connected with it. If thence they escape to the soil by soaking into wells, they poison the drinking-water. This is a common and dangerous way by which this fever spreads. To prevent such consequences, the discharges should be disinfected on their escape from the body as previously directed. This is the *chief* precaution to be attended to, and if effectually done, removes almost all the risk of infection.

TYPHUS FEVER.

14. This is a much more "catching" fever than the preceding, and is caused by over-crowding and deficient ventilation. It is apt to attack those who are much exposed to it for the first time. It is therefore better to have a nurse who is protected by a previous attack. The poison is thrown off by the skin and lungs and readily infects clothing, furniture, etc.; so that the chief precautions are those of ventilation and disinfection.

SMALLPOX.

15. The perfect protection from this disease is *efficient vaccination.* This is known by a *good large mark*, or *scar.* Re-vaccination after the fourteenth year is advisable. An unvaccinated case of smallpox in Scotland is so rare, that precautions in regard to it are needless. Should such a case occur, the precautions already named should be most strictly adhered to, as it infects at a greater distance than any other infectious disease.

DIPHTHERIA.

16. Diphtheria poisons by means of the breath and expectoration ; and the utmost precaution to avoid contact with these on the part of those about the patient is absolutely necessary. The expectoration should be received into a vessel containing Condy's Fluid, or on cloths that may be at once burnt ; and the throat frequently gargled with a solution of the same, of the strength of a small teaspoonful to a quart of water. A mother should on no account kiss her children during this, nor, indeed, any of the other infectious illnesses.

WHOOPING-COUGH.

17. Whooping-cough is a disease to which children are more especially susceptible, and most fatal to children under two years of age. It is so extremely fatal to infants, that every effort should be made to keep them out of the range of the infection by separation. The poison comes chiefly from the mucous secretions of the lungs and air passages, and is readily imparted to the clothes of those who nurse the patient. These secretions are infectious from the beginning of the illness.

ASIATIC CHOLERA.

18. This only occasionally visits this country. As in typhoid fever, it spreads by means of the bowel discharges ; and the same precautions are necessary.

GENERAL STATEMENTS.

19. In any of these infectious diseases, where there is not sufficient accommodation for fully carrying out these precautions, it is urgently recommended that the patient be removed at once to the Hospital appointed for the reception of such cases. It need hardly be added, that no time should be lost in obtaining medical advice when any of these diseases appear.

20. We abstain from giving directions as to the disinfection of a house either after death or recovery, as the authorities gratuitously and efficiently do this when applied to ; besides making ample compensation for any articles of furniture, &c., they consider it necessary to destroy.

Edinburgh Health Society.

HEALTH LECTURES

FOR THE PEOPLE.

Illustrated.

SECOND SERIES.

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CONTENTS.

EDINBURGH
HEALTH SOCIETY.

INSTITUTED 1881.

PRESIDENT.

THE RIGHT HON. THE EARL OF ROSEBERY.

THIS SOCIETY has been formed :—

To promote, *by all means in its power*, attention to personal and domestic Cleanliness, to Comfort, Self-denial, Temperance, and the Laws of Health generally.

The Means to be employed for this end may, in the opinion of the Committee, be stated in the meantime as follows :—

1. The delivery of Popular Lectures bearing on the subjects in question by Physicians and other qualified persons.
2. The printing and distribution of these Lectures, and of small Leaflets.
3. Providing subjects of Interest for the Mind, and encouraging proper Amusements and Physical Exercises.
4. Giving assistance to the Constituted Authorities in the promotion of sanitary improvements by drawing their special attention to any particular insanitary condition.
5. Obtaining the assistance, so far as necessary, of any other Society in the City willing to co-operate in the work of this Society.
6. Arranging for the *re*-delivery of the Society's Lectures in villages in the neighbourhood of Edinburgh, and for the formation in such places of small *local* Committees in connection with the Society.

Members Enrolled and Subscriptions Received by :—

The Honorary Treasurer—ROBERT COX, Esq., Gorgie.

The Honorary Secretary—WALTER A. SMITH, Esq., 24 Hartington Place, Viewforth.

Messrs MACNIVEN & WALLACE, Publishers, 144 Princes Street.

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PREFACE.

In publishing this volume of Lectures, delivered in connection with the Edinburgh Health Society, the Committee of Management think it will be interesting to the Public to refer to the work which has been done during this, the first session of the Society. In the first place, this work has consisted in the delivery of the lectures now printed. These lectures were listened to by large and attentive audiences, numbering on an average two thousand, and the Committee feel sure that many important hints were given in them, and they trust that these hints will be made use of by those who heard them, and also by many more who may now read them. The Committee and the Lecturers have been much gratified with the very large numbers of the working classes who have attended the lectures, as evincing the interest taken in them by those for whose benefit they were chiefly intended; and they have also been pleased with the orderly behaviour and the great courtesy which has been shown on all occasions, without exception, to them, to the Chairmen, and to all connected with the Society.

The second work carried on by the Society, principally through the Committee, has been to make arrangements for the *re*delivery of these lectures in some of the smaller towns in the outskirts of Edinburgh, showing that the interest in this Society is not confined to Edinburgh, but is extending outside of it. It may perhaps interest some to know that an application has been received from Iceland to have the lectures sent there in order that they may be translated into the language of that country and made useful to the inhabitants.

The third work done has been to consider and discuss many important questions in connection with health and sanitation. In regard to some of these questions, it was decided that it was better not to interfere, and in regard to others, information is still being sought. The Committee wish it to be understood, that the object of the Health Society is not to come into collision with the authorities, but rather to co-operate with them. It does not wish to embarrass or to force legislation; neither do its members wish to make themselves disagreeable in any way. All they want to do, is to educate the public to observe and work for themselves; and the Committee hope, that in time, it will not be necessary for the Society to go to the Public, but that the Public will come to the Society and ask them to assist them in connection with many important health matters.

With reference to the financial condition of the Society,

the Committee are glad to say that, so far, the money obtained has been sufficient to meet all the current expenses. The Committee desire it to be distinctly understood, however, that the Lecturers have not only given their services *free*, but that many of them have most kindly been at considerable outlay in providing illustrations for their lectures. The expenses have been only in connection with the hall, and in paying for advertising and printing. Up to this time, 207 members have joined the Society. Considering the large audiences who have benefitted by the Lectures, the Committee consider this number rather disappointing, and they trust that it will soon be largely increased. It entirely depends upon the support given, not only of money but of influence, what amount of good the Society can do. The Society is very anxious to do a great deal. It is very anxious, for instance, to provide proper means of Amusement for the People, such as a suitable Gymnasium, so that young men and women, when the weather is wet and the days are short, can go to an airy hall and practise Physical Exercises and have other innocent amusements, which are so essential to their general health. But this cannot be done without additional funds, obtained from a much larger Roll of Members. It is therefore hoped that all will help the Health Society, not only with their money but with their interest, and such help will be a great spur to the Committee to continue their labours in promoting the health and happiness of their fellow citizens.

In conclusion, the Committee cannot omit to give their sincere thanks, in the name of the Health Society, to those distinguished gentlemen who have so kindly and so successfully delivered, without thought of remuneration, the lectures during this session. These gentlemen must have the pleasing satisfaction of knowing that they have done much to assist the objects of the Society and to promote the well-being of the community.

SOME LESSONS FROM MODERN MEDICINE.

By J. A. RUSSELL, M.B., F.R.S.E.

Dr J. A. Russell, in treating of "Some Lessons from Modern Medicine," said:—The wonderful progress of the arts and sciences in modern times has often been said and sung, but it is not generally known that in none of them has greater improvement been recently made than in that art which affects us all so closely, because it deals with our very persons. Not only is this the case as regards ground already gained, but at this moment the science of medicine more than any other is rich in promise of benefit to mankind in the near future. That this should fail to arrest attention is not wonderful. The way to attract the admiration of the multitude is to cause human misery, not to cure it; to slay men in thousands. not to save them. Alexander, and not Hippocrates, is called the Great: Napoleon the First, and not the inventor of chloroforming, is the Hero. Moreover, discoveries in medicine often require technical knowledge to understand them, or they apply merely to sick people; or, what appeals still less to the imagination in healthy persons, they merely show how to ward off disease from those who feel no present ill.

There are indeed those who deny that any discoveries are made, or any progress gained. These are persons who do not believe in science, but believe in themselves, and who usually unite extreme credulity to scepticism. Because medical art cannot meet all demands upon it, and honestly acknowledges the fact, they dub the science conjectural, and, refusing credence to whatever is demonstrable, plain, and reasonable, put the blindest faith in whatever is mysterious and unknown. Such was Madame de Sévigné, who, never wearied of uttering sarcasms on the inanity

of medicine, at the same time inundated her friends with a mass of absurd remedies; and many now resemble her in this who want her wit.

Putting aside for the present the gains by sanitary science, and advances in the principles of medicine, let us call before us a single advance in the details. Twenty years ago the operation of ovariotomy could only be attempted at the risk of a criminal prosecution for performing an operation so dangerous as to be unjustifiable. Patients suffering from the disease which this operation cures had then the prospect of inevitable death in about two years. To-day it is one of the safest operations known to medical art, and one surgeon is able to boast that he has added upwards of ten thousand years to the sum of the lives of his patients.

If we ask how the knowledge of these bounteous gifts of medical science to civilised man has been attained, we find that it comes mainly from three sources. We have *firstly* the advance in chemistry and other branches of physical science, and the invention of instruments such as thermometers and microscopes to aid and enlarge the powers of our senses; or of instruments contrived to take direct records of fact, which are independent of the fallacies incident to the use of our own senses.

The discovery of chloroform was due to pure chemical research, though its anæsthetic properties were afterwards ascertained and applied by Sir James Simpson. Let Sir James draw the lesson in his own words:—"It is perhaps not unworthy of remark, that when Soubeiran, Liebig, and Dumas engaged, a few years back, in those inquiries and experiments by which the formation and composition of chloroform was first discovered, their sole and only object was the investigation of a point in philosophical chemistry. They laboured for the pure love and extension of knowledge. They had no idea that the substance to which they called the attention of their chemical brethren could or would be turned to any *practical* purpose, or that it possessed any physiological or therapeutic effects upon the animal economy. I mention this to show, that the *cui bono* argument against philosophical investigations, on the ground that there may be at first no apparent

practical benefit to be derived from them, has been amply refuted in this, as it has been in many other instances." Surely no one in this audience who has undergone a surgical operation in blessed unconsciousness, or still less any one who has endured the pain chloroform could defy, will ever again say, "where's the use," or cast ridicule on those who strive to add to our scientific knowledge without having an immediate practical end in view.

Not only do we now possess an array of drugs unknown forty years ago, which put additional powers within our reach; but the intimate action of the old drugs, whether upon muscle or nerve, heart or brain, has been so elucidated that they are used in quite a new way, and so promising is the outlook that Professor Huxley says, "It will, in short, become possible to introduce into the economy a molecular mechanism which, like a very cunningly contrived torpedo, shall find its way to some particular group of living elements, and cause an explosion among them, leaving the rest untouched." I fear that this desirable torpedo will not be discovered in Edinburgh, for the Secretary of State has recently refused a license to our Professor of Materia Medica to perform a few experiments on frogs and rabbits with a drug from Borneo where it is used to anoint the arrows of the natives. The operation for which leave was refused is identical with that performed by nurses every day, when medicines are administered subcutaneously with the aid of a syringe and hollow needle. For aught we know this drug may possess some property that would relieve some one near and dear to us from suffering and sickness, and save us from anxiety and grief; but the man, whom we in Edinburgh have set apart as specially competent to make enquiry for us, is arrested through the action of a small body of zealots, who insist that their zeal, though not according to knowledge, shall be testified in *our* unabated pains and recorded in *our* losses.

The invention of instruments for observation has had much to do with alterations in medical treatment, by giving such clear indications, that the physician can avoid doing wrong, even if he does not know how to do right. As an example of change of practice, I may mention that in the year 1833 one of the London Hospitals used 48,900 leeches, while last year it used only 250.

Statistics.—The second source of medical knowledge that I would mention is Statistics, which are now applied to the investigation of innumerable problems and have been fruitful of important information in the most unexpected quarters. They render great service in testing opinions. Opinions differ from facts in that they lie in the nebulous region between the known and the unknown. They form too unstable a foundation for the erection of any weighty system of practice, but when tested and found to rest on the firm rock of fact another step forward can be taken.

Twenty years ago no one knew of the association between pulmonary consumption and a damp subsoil, but statistics have fully proved the connection. In fifteen English towns recorded by Mr Simon the deaths from consumption fell immediately when the subsoil was dried by a system of drainage. In Salisbury the deaths from consumption fell 49 per cent.; in Ely, 47 per cent.; and Merthyr Tydvil, which gained least, had its death rate from consumption lowered by 11 per cent. By statistics we were pointed to the high mortality from consumption in the British army, and especially in the Guards, due to confined air—a mortality which has been so affected by better ventilation of barracks that the consumptive death rate fell in the Guards from 125 in 10,000 in the year 1858 to 16·9 in the year 1875, that is to say, the deaths from consumption alone in the Guards in 1875 were less than a seventh of the number in 1858. By statistics we learn that drapers die at a rate of 108, compared with 76 of grocers, and we also learn that this excess of deaths, in a class of men who live as a rule under similar social conditions to the grocers, is due to asthma and other pulmonary complaints, and are thereby pointed to the cause in close, ill-ventilated shops, having an atmosphere laden with fluff and dust, and windows and doors blocked with goods. The grocer, on the other hand, owes his favourable position on the scale of mortality to an active trade carried on in an open, well ventilated shop, with the door usually wide open. By this same method we can trace the effect of each different trade and profession upon health and longevity, and are brought to face such questions as, why hairdressers should have a mortality half as great again as that of the agricultural labourer, or why publicans should die almost

as rapidly as cabmen, and at just twice the rate of the clergy. The answers to such questions deserve our careful study, for they point out the direction in which improvement is required, and whether the reform is of that small class which can be accomplished by the summary method of legislation, or whether it requires a change in social habits, or alterations in the conditions of living and working. We can not only compare one trade with another, but can discover the influence of race and its associated customs in the exceptional longevity of the Jews all over the country. The influence of social customs among ourselves can be examined in the same way, and when we find that total abstainers live longer than other classes of the community, we are prepared to believe that they are self-selected—in part at least—by their native vigour of constitution, and that they can eat more and probably work more than non-abstainers.

We may almost say that through statistics we can prophesy the future, for such is the regularity of nature, and so unvarying are her operations under similar conditions, that though nothing is more uncertain than the time of death of any single individual, yet nothing is less liable to vary than the age at which each thousand of 100,000 children born in any year will have passed away, and so much do varying circumstances tend to balance each other, that the number of accidents on the London streets may be very closely predicted for any day.

This is what renders Life Assurance possible, and has done so much for the promotion of thrift, and social improvement of the middle classes of society. The same boon is now offered to the wage earning classes through the post-office and assurance companies, with schemes for insuring against death or sickness specially adapted to their circumstances.

In the prospectus of a new company—the Scottish Life Assurance Company, Limited—which has instituted a thrift department as a specialty, I see that at age twenty-one £100 with profits may be insured for 3s. 4d. per month, or £50 with profits for 1s. 8d., a sum which will not keep the pipe of an ordinary smoker alight for the same period. The practice of life insurance is to be commended for its moral consequences as well as on other grounds. It aids virtue and increases self-respect, by giving the

assurance, that not death itself can prevent the discharge of those obligations to our families and society, to which we are in honour bound. It is well then that any doubts respecting the foundations of insurance can be quenched in the cool clear waters of scientific certainty. The intention of insurance being to render us independent of the uncertainty of life and provide a fixed sum at death by contributions to a common fund, it is plain that those who die early contribute least to the fund, and that the long livers are in a sense the financial losers by the arrangement, for they have to make good to the fund the sum beyond their contributions carried off by those who die before they attain the average age for which the premium is calculated. If each person could foretell the time of his death there would be no insurance, for the long-lived would refuse to join purses with the short lived; and even now, stringent precautions are taken to exclude this class, who will find it increasingly difficult to get insured, as medical science advances, and is more and more able to predict the future.

Preventive Medicine.—Let us now turn to the statistics, without which preventive medicine could not exist, and let us see what this branch of medicine, which teaches that it is easier to *keep* out of illness than to *get* out of it, has been able to do for the health of the country.

We find in the Registrar General's returns for England and Wales that the death-rate for—

1841-51 was 22·33.	1861-71 was 22·50.
1851-61 „ 22·25.	1871-81 „ 21·27.

So that here is a very marked fall in the last ten years. From these figures, it is seen that during the thirty years from 1841 to 1871, the death-rate did not increase, though all over the country a rapid change in the distribution of the population was taking place—a change, the natural consequence of which is greatly to increase the death-rate. The country population is nearly stationary in number; while the rapid growth is altogether in urban districts. In Scotland, during the last ten years, the larger towns increased 37·37 per cent. in population; while the Mainland rural districts only increased 2·81 per cent.; and the population of the

Insular rural—the healthiest districts of all—actually diminished in number by 1·3 per cent.

In England and Wales it is not so easy to define what is town and what is country; but, at the late census, the proportion of persons living in places which, for one reason or another, were considered to be of sufficient importance to exercise urban powers, to persons living elsewhere was 212 to 100; or, if we reckon as rural all places with populations under 3000, the proportion of dwellers in towns is 66·6, and in country 33·4, and on this basis the estimate of town population would be in 1861, 165 dwellers in town, to 100 in country. At the census of 1871, the number had risen to 184, and in 1881 had reached 199; so that this year, the number of dwellers in towns is almost exactly double the number of dwellers in the country.

Now, if there is one fact more than another which the Registrars-General, both in England and Scotland, delight to din into our ears, and to illustrate and prove in every report, it is that, just as the density of the population increases so does the death-rate—that, in fact, the nearer people live to each other, the shorter their lives are. They show that where the density is 166 persons to the square mile, the death-rate is 17 per thousand, where it is 1,718, the death-rate is 25, and where the population is 12,357 per square mile, the death-rate is 38 per thousand. The Registrars-General are so impressed with this fact that they delight to turn it over and present it to us in all kinds of different aspects. Sometimes they arrange us by the acre, as you would see in Dr Smart's lecture last year on Preventible Diseases. Sometimes they imagine us spread separately over the ground, and they measure our distance from each other in each district, and call it our proximity in yards, but always with an unvarying result—a higher death-rate accompanies proximity to each other, and the nearer to each other in yards we are, or the more of us there are upon an acre, the higher the death-rate. Thus it is shown that in 53 districts, where the proximity is 147 yards, the mean duration of life is 51 years. In 345 districts, where the proximity is 39 yards, the mean duration of life is 45 years. In 137 districts, where the proximity is 97 yards, the mean duration of life is 40 years. In 47 districts, where the proximity is

46 yards, the mean duration of life is 35 years. In the Manchester district, where the proximity is 17 yards, the mean duration of life is only 29 years. And in Liverpool, where the proximity is 7 yards, the mean duration of life is only 26 years. Has then sanitary science accomplished nothing between 1841 and 1871, when, in the face of such a law and the growing aggregation of people into towns, it has prevented the death-rate from rising?

It has done more than this, for if we examine the statistics of the last decade, 1871-81, when sanitary measures have begun to bear fruit, we find that the death-rate has fallen about 4½ per cent. in England and Wales, viz., from 22·5 to 21·27; while the lower death-rate of this decade, says the Registrar-General, "implies the survival of 299,385 persons, who, with the previous rate of mortality, would have died." A report states that—"if twelve cases of serious, but non-fatal illness, be reckoned for every death, it follows that about three million persons, or over *one ninth* of the whole population have been saved from a sick bed by some influences at work in the past decade, which had not been in operation previously." Of this reduction, which is "only an instalment of sanitary progress," more than three quarters is due to a fall in the deaths by the seven zymotic diseases, from 4·14 per cent. to 3·36 per cent. Those diseases "are the most influenced by sanitary improvements, and the most easily controlled by sanitary authorities." "And of this three quarters, just half or three eighths of the entire reduction is in fever—the disease which, more than any other, shows itself in connection with such faults of drainage, of water supply, and of filth accumulation, as it is within the province of good sanitary administration to remove. The fever death-rate has fallen steadily from 80 per 10,000 in 1870 to 32 in 1880.

EDINBURGH. — Looking nearer home, I find from a table kindly given me by Dr Littlejohn, that if the ten years, 1870 to 1879, be divided into two periods of five years, there is a fall in the death-rate from 22·88 in the first quinquennium to 20·82 in the second, and that the whole of this gain is due to a fall in the zymotic rate from 4·59 to 2·43. This, though a gratifying tribute to the usefulness of our Health Department, shows

that the conditions which produce our mortality otherwise are not affected, and a death-rate even of 21 per thousand in a city like Edinburgh, not crowded by a poor industrial population, challenges the serious consideration of her citizens. The Registrar-General in his last detailed report gives our mean annual mortality as higher than that of Aberdeen, Leith, or Perth, and it becomes us therefore to inquire, what can be done to counteract the operation of the law of density. That the inhabitants do not much fear the operation of this law, is to be inferred from the stipulations as to new streets and buildings, inserted by them in their local Police Act of 1879. While in London no street may be less than forty feet wide, exclusive of any gardens, open areas, fore-courts, or other spaces in front of the houses ; in Edinburgh the minimum width of a new street is only twenty feet, and moreover the width is to be measured from the houses or buildings. In London the height of a house must not exceed the width of the street. In Edinburgh the house may be once and one-half times as high as the width of the street. With such regulations as it possesses, and the very great number of public commons surrounding it, London may continue to grow in size, but not in density of population, and will continue to be the healthiest large city in the world. The contrast between Edinburgh and London in these respects seems fitted to excite some anxiety for our future, and may well call for such interest in the public health, on the part of the citizens, as shall influence municipal action. In health, as in other matters, the citizens must look to their own interests, and they cannot expect that the Medical Officer and Health Committee either will, or can, march on in advance unsupported by public opinion. Those in an official position, unless supported by the public, will always feel weak when enforcing health acts upon persons whose self-interest is opposed to healthy surroundings for others.

But some one will ask, in what way does density kill us ? and I answer, mainly by inducing three great causes of preventible mortality :—*First,* ZYMOTIC DISEASES, which smite chiefly the juvenile population from birth to puberty, and are as a class associated with filth. *Second,* PULMONARY COMPLAINTS, such as consumption that chiefly prey upon early adult life, and are

largely associated with confined air. And *Third*, DISEASES OF THE ORGANS of the body which mostly attack those in middle age, and are associated with intemperance.

Then, can the action of this law of density be suspended or modified? Not in ordinary conditions; but exceptional discipline, unlimited wealth, and energetic sanitary action can modify the law. The true cure for the law is that given by Dr Farr, who says—"It is certain the most effective means of reducing mortality is to thin the dwellings of the denser parts of the population, to abolish all rookeries, and not to rebuild them." In prisons the death-rate is low, very low, but there discipline is paramount. In the Peabody Model Lodging-houses, London, the death-rate is alleged to be only 16·7 per thousand for the last 16 years, while that of crowded neighbouring districts is 30 to 40; but the class who inhabit them is higher in the social scale than was intended, and the trustees began with half-a-million sterling, and now have £720,000. The effect of energetic sanitary action is seen in the reduction of the Glasgow death-rate to a point, still high, but far below that fixed by the law of density. The credit of this improvement is greatly due to the Hon. Lord-Provost Ure, who, aided by a distinguished medical philosopher, as adviser, has saved more lives than any other man in Scotland.

If we are to depend solely upon sanitary action to countervail the operation of the law of density, we shall be like a ship that puts to sea with a leak, and whose safety depends upon unremitting pumping. And who are those chiefly interested in keeping the pumps going? Undoubtedly those struggling to maintain a respectable and honest independence, to whom the loss of time and means which is involved by illness, or by having to support broken-down neighbours by rates or charity, threatens a break-down for themselves, and loss of their position and self-respect. This class, then, so helpless individually, should pay special attention to the way in which their health is treated by the Local Authority.

I shall be told that if I attack density I trench upon the rights of property. Now, I would be most careful of rights of property. There is no property to which a man has a better

right than to his own health; and wherever alterations or operations are proposed, that would infringe upon this, which is every man's property and the poor man's sole capital, is it not fitting that these alterations should be controlled by sanitary legislation? The rights of property of some men when examined turn out to be wrongs to the property of others. It seems fair in most cases that landlords' existing rights of property in towns should only be touched by improvement schemes that give compensation. But has any man a right *of new* to crowd buildings upon the ground to such an extent as to shut out light and air, and give him double feu-duty, at the expense of the health of the residents? Is not the additional feu-duty that is derived from buildings erected in addition to those allowed by Sanitary Science, so much money taken out of the pockets of the community, and an injury to the property of others? Am I not injured, if, to give excessive feu-duty to a landlord, my neighbour is so crowded as to fall sick? Am I not injured when I am deprived of his services? Am I not injured when I support him in the Infirmary? Am I not injured when I support him in the Poorhouse? Am I not injured when I support his sons in Reformatories and Prisons? And am I not injured when his daughters, instead of being a source of purity and strength to the community, become a cause of weakness and decay? Let us have the allowable density of buildings fixed by enactment at a standard compatible with health, and then a "fair rent" is found by competition.

Compensation.—But is compensation not required and due? I say, wherever it is due, by all means let it be paid; but first make sure by whom it is due. To illustrate this, I shall quote from a paper by Dr. Russell of Glasgow upon a case where compensation was demanded, consequent upon alterations ordered by the sheriff to correspondingly improve the ventilation of a building, in which the population had been trebled by subdividing it into single-room dwellings. These alterations spoiled six apartments renting altogether at £27. Dr Russell says:—

"Much emphasis was laid by the respondent upon the fact that the destruction of those six single apartments was a loss of rental amounting to £27 per annum, the houses being let at £4, 10s. each. This was designated an unwarrantable "confis-

cation of property," and "compensation" was insisted upon. It was asserted by architects that the consequent improvement on the property fully balanced this apparent loss, and that it must even be recompensed by a larger rental for healthier houses. But, let us take the loss of £27 per annum as an absolute loss, what is this in view of the enormous death-rate and propagation of sickness, evidently begotten of conditions which the sacrifice of this sum is intended to remove or mitigate? This mortality and accompanying loss of health and working-time on the part of the adult working population, prevailing through a period of years, represents a sum of money taken out of the pockets of householders and of rate-payers, and for whose sole advantage? If there is to be any discussion of 'compensation,' it must evidently be in the way of compensating the public." "The rental of those houses, let in excess of the number consistent with conditions of public health and safety, ought to be a charge against the property on the principle of higher premium of insurance required against a hazardous risk." But I shall be told, those houses were taxed upon their rental for sanitary purposes, and therefore contributed their fair share to the expenditure of the community on this behalf. Let us take the rental of these thirty-nine single apartments at £5 a-piece, and of these six double apartments at £8. This gives an assessable rental of £243, say £240. Being under £10 in each case, the assessment for sanitary purposes amounts to 20s. at 1d. per pound, and for hospitals under the Public Health Act, to the large sum of half-a-crown, at one-eighth of a penny per pound. This is a contribution of £1, 2s. 6d. per annum or £9 in the eight years. Of that not a penny is paid by the owner. During that time twenty-three cases of infectious disease were removed to the sanitary hospitals, and treated at the public expense. For keep, treatment, and share of rent-charges, up-keep of buildings, &c., &c., £5 is a moderate estimate of the cost of each of these cases. This amounts to £115 for this item alone! Besides, there is the expenditure for maintaining a staff of men to form a cordon of inspection and observation from day to day around such properties. It would be well that the ratepayers should remember those figures in the face of demands for 'compensation' and *ad miseri-*

cordiam appeals made by the respondents in this and similar cases. The fact is that every such property is a sort of running sore upon the body of the community, diverting its substance from healthy uses, and draining the life-blood of the public. There is scarcely a fraction of the sanitary assessment drawn from the west end of Glasgow, or the shops in Buchanan Street, expended directly upon the west end or in Buchanan Street. It is spent upon the miserable properties which are the plague spots of the city, in a vain endeavour to keep down their disease and death-producing effects, the owners meanwhile pocketing the rents nett, so far as sanitary assessment is concerned, and crying out, 'confiscation,' 'compensation,' the moment an attempt is made to reduce this expenditure by operating upon its causes."

Rent.—Apart from political pressure, private individuals can do something to exempt themselves from the law of density. They can take the best house their means will afford. And here I earnestly commend the Glasgow health lecture, "The House," for its practical advice, and its clear statement of the moral and physical consequences of deficient house room. Workmen have often complained to me of the high rents and comparatively small number of houses suited for working men in Edinburgh. They complain that the rent of a large house may be only 4 per cent. upon its value, and yet 10 per cent. upon value may be charged for low-class property. But what is the reason of this? Is it not the difficulty and trouble of collecting small rents, the risk that some of them may not be forthcoming or of moonlight flittings, and the tremendous dilapidation caused by reckless tenants? Is it not the case that the wealthy tenant causes little damage, and will often repair it himself rather than trouble his landlord, while the rough and ignorant poor tenants smash and spoil and choke whatever can be injured? If the erection of workmen's houses paid even 5 per cent. without trouble, would there not be a rush of capital to build them? This is just an instance of the good being punished by high rents for the faults of the bad. The only way in which the working classes can have cheap houses seems to be for them generally to do as many of them have already done, and buy their houses for themselves. With the aid of the investment companies, in which Edinburgh abounds, this can be accom

plished. All that these companies require is that the applicant shall produce such a sum as may prove that he is in earnest, and secure them from loss. Of course, where boys marry at twenty-one, or earlier, as soon as they have escaped from their apprenticeship, it cannot be expected that they can do anything of this kind. But I fail to see why they need marry until they prove their respect for their intended wives and their intention not to depend upon charity in every little calamity, by doing something towards providing a home.

Opposition.—Ere passing on from the head of Vital Statistics, we may profitably ask how they were received when first introduced. The first bill for taking a census was introduced into Parliament in 1753, but defeated by such language as the following:—Mr Thornton, member for the city of York, said—"I did not believe that there was any set of men, or indeed any individual of the human species, so presumptuous and so abandoned as to make the proposal we have just heard." And Mr Matthew Ridley, member for Newcastle-on-Tyne, said—"The people looked upon the proposal as ominous and feared lest some public misfortune or an epidemical distemper should follow the numbering." These gentlemen belonged to a class which is active at the present day, and which although opposed to progress, has advanced so far as to form a number of Societies recognisable by the prefix Anti to their names—as Anti-vaccination, Anti-vivisection. The members of the sect of Anti-..s are eminently respectable; many of them are philanthropic and pious; all of them are unreasonable and opposed to progress. The sect has always shown a remarkable tendency to wrest Scripture. Their formula, which they apply to every advance in knowledge, is this—First, It is not true; Secondly, It is contrary to religion; and, thirdly, It is not new, or we knew it all before. Such a venerable sect deserves a history, but time will only permit me to go back to the year 1600, when we find the sect embracing several cardinals, and in such high power that, through the Inquisition, it pronounced sentence upon Galileo, the astronomer and inventor of the telescope. Part of the sentence runs as follows:—"To maintain that the sun is placed immovable in the centre of the world, is an opinion absurd in itself, false in philosophy and formally heretical,

because it is expressly contrary to the Scriptures; to maintain that the earth is not placed in the centre of the world, that it is not immovable, and that it has even a daily motion of rotation, is also an absurd proposition, false in philosophy, and at least erroneous in point of faith," It will be instructive just now to consider the terms of Galileo's reply to this, in his letter to the Grand Duchess of Tuscany. He says: — "I am inclined to believe that the intention of the sacred Scriptures is to give mankind the information necessary for their salvation, and which, surpassing all human knowledge, can by no other means be accredited than by the mouth of the Holy Spirit. But I do not hold it necessary to believe that the same God who has endowed us with senses, with speech, and with intellect, intended that we should neglect the use of these, and seek by other means for knowledge which they are sufficient to procure us; especially in a science like astronomy, of which so little notice is taken in the Scriptures that none of the planets, except the sun and moon, and once or twice only Venus, under the name of Lucifer, are so much as named there. This, therefore, being granted, I think that in the discussion of natural problems we ought not to begin at the authority of texts of Scripture, but at sensible experiments and necessary demonstrations; for from the Divine word sacred Scripture and nature did both alike proceed, and I conceive that, concerning natural effects, that which either sensible experience sets before our eyes, or necessary demonstrations prove unto us, ought not upon any account to be called in question, much less condemned upon the testimony of Scripture texts, which may under their words couch senses seemingly contrary thereto."

The sect of Anti-...s has attacked every step forward in physical science; but its choicest comminations have always been devoted to improvements in medicine. Of course such a venerable and respectable sect included some doctors, so that many of the attacks have come from within the profession. Before the method of tying vessels with ligatures was invented, the only method in use for arresting bleeding in amputations was the barbarous one of searing the stump with a red-hot iron, or of plunging the limb into boiling pitch. When Paré in-

troduced his method of tying bleeding vessels with ligatures it was received with the bitterest abuse. From that time the next important appearance of the sect was made in connection with the introduction of the practice of vaccination. An anti-vaccine society was forthwith formed to protest against "a gross violation of religion, morality, law, and humanity." "The projects of these vaccinators," it was said, "seem to bid bold defiance to heaven itself—even to the will of God."

Sir James Simpson said—"Every proposed improvement seems to be met with the same invariable array of objections and arguments. The discovery may be new, but the grounds of opposition to it are not new, they are merely the old forms of doubt and difficulty and prejudice used on former occasions recalled and reproduced anew." This sect came to the front more at the time of the invention and application of chloroform and of anæsthetics generally than at any other time. Within the medical profession itself many men were exercised about the abolition of pain, and putting patients to sleep. The clergy became involved in the contest, from bishops downwards, and especially when Sir James Simpson proposed the use of chloroform in midwifery; and objections were so many and so varied that I verily believe Sir James Simpson showed more cleverness in combating the Scriptural and other objections than he did in introducing chloroform. Take a characteristic example. Dr P. of Liverpool said:—"I became increasingly aware that I must trench upon what might really appear to be exclusively the province of the Divine, but in which, nevertheless, in our own professional standing, and in the standing of baptized men, as opposed to heathens, we must assuredly have our place, and that a most important one." "What right have we, even as men, to say to our brother man, 'sacrifice thy manhood, let go thy hold upon that noble capacity of thought and reason, with which thy God hath endowed thee and become a trembling coward before the presence of mere bodily pain. What right still less have we as baptised men—men having a Redeemer, and gifted with the Holy Spirit to be our Comforter—what right have we, ungratefully or unbelievingly, to forget all this and be willing to go under the deep stupor of a power, the influences of which and connected with which, we know so exceedingly little?" It

is perhaps not wonderful that he should go wrong in his theology; but when he comes to medicine he is just as bad. He says:— "Besides, we have as yet no time to watch *other* consequences; but one, I fear, in particular will become more common—I mean insanity; I wish I may be mistaken, but I greatly fear it." The same people who, in the early days of the application of anæsthetics in midwifery, insisted upon the "propriety" and the "desirability" of pain, and who demanded that the accoucheur should take upon himself the function of executioner of the curse denounced in Genesis chap. iii. ver. 16, "in sorrow thou shalt bring forth children," now-a-days revile and decry any one who endeavours to learn how to save men and women from suffering by inflicting the most trivial pain upon a frog.

Experiments.—The *third* great cause of advancement of medicine to which I intend to allude is experiments upon animals. These are either made on a large commercial scale upon men, or on a very small scale for precise scientific ends upon the lower animals. Since 1873 sixty-seven grave experiments of the former kind were made upon the population with infected milk; that, in fact, putting on one side commercial experiments with water, with infected clothing, and with infected dwellings, we had sixty-seven epidemics from infected milk alone. In the commercial experiments with typhoid fever poison in milk, 3500 persons were involved, and in the commercial experiments with scarlet fever poison 800 persons were involved, and in diphtheria poison 500. In the fifty epidemics of typhoid, twenty-two were due to "washing the cans," or what milkmen call washing the cans, with foul water. The year 1873 is not so far back, and we need not find it difficult to appreciate these figures. It is important that you should be aware that the means of controlling these fevers are at the present day crowding upon us through experiments upon animals, especially through the experiments of a distinguished Frenchman, Monsieur Pasteur, who has added enormously to our knowledge and to our resources. He has been able to cultivate out of the body the poisons which cause certain diseases, and he has shown that in one of the fevers which we call splenic fever, and which affects man and animals alike, the poison is a vegetable of a very low form of organization. Dalton, the chemist and inventor of the

Atomic Theory, said he could never think of the atoms without thinking of them as penny pieces. In the same way we may think of these organisms as beans with stalk and seed, and this will help us to realise that the effect of these organisms, and the development of the disease depend partly upon whether we have been infected by the plant or by the seed. This explains, also, how it is that sometimes the infecting power is fugitive, while at other times it puzzles us with its long-continued infective properties. The plant is very easily killed, but the seed is very enduring and possesses great vitality. Cold will kill a plant, but cold will not kill a seed.

Pasteur has also investigated a disease called Fowl-cholera. It has nothing whatever to do with cholera, and only resembles it in that it kills fowls very rapidly. He has discovered that this disease is due to a low organism, which can be cultivated, and grows very rapidly in chicken soup. He took a vessel of chicken soup, and dropped into it a drop of infected blood about the size of a pin's head, and he found that it soon infected the whole bowl. Presently a change took place in the soup, the organism could be seen under the microscope, and the infected chicken soup was now a virulent poison for fowls. But not only so, M. Pasteur observed that you can pass on the infection from one bowl of soup to another by merely putting a drop of the infected soup into the new and fresh fluid, and so on to a thousand bowls it might be; and that if you take a drop from the last of them and, having scratched a fowl, inoculated it with the fluid, it will take the disease and die. These experiments were repeated until there could be no doubt as to their accuracy. This is the stage which was reached last year when Dr Smart gave his lecture. But M. Pasteur has gone far beyond that within the last twelve months.

He can now produce a modified splenic fever, or a modified cholera of fowls. That is to say, by a suitable cultivation of these organisms, he can so change the properties of the plants that, when a fowl is inoculated, it shall take the disease in an easy way, and shall not die. But, more than that, the effect of the modified disease is as good as if the fowl had taken the disease in its severe form, so far as preventing its recurrence is

concerned. And he has managed in this way to inoculate the fowls with a tamed virus which confers a protective influence and yet ensures that the fowl shall recover. Of his methods of doing this I shall not speak further than to say, that one of the agents which M. Pasteur used in taming the virus is oxygen, and this seems to point to one way in which fresh air may influence the poisons of specific diseases. Indeed, Mons. Pasteur can so tame the organism that it will no longer give rise to any disease at all, and he has discovered where to stop short in the cultivating or taming process, so that he shall get the protective influence of the disease without killing the fowl. This process has been applied by him on a large scale in the treatment of the splenic fever which devastates whole herds of oxen and flocks of sheep on the Continent. In the course of his experiments he inoculated twenty-five sheep with the cultivated virus, and other twenty-five with the virus which had not gone through the cultivating process. The result was that the whole of the twenty-five that were so treated with the uncultivated virus died within fifty hours, whilst of the twenty-five inoculated with the cultivated virus not one died, and yet they were found afterwards to be insusceptible of taking this disease. Whenever this was made public, there was, of course, a rush of the farmers all over France to get their cattle inoculated, and the cattle are now being inoculated in thousands every day. So that here we have a remarkable instance of the experiments on animals benefitting the animals themselves in the first instance. M. Pasteur has followed up these researches with the most admirable ingenuity. Thus he has found that the spores of anthrax may last for over twelve years, and that oxen may take the infection from them through grazing over ground where previously other oxen had been buried, and where the spores of the disease had been brought up to the surface from the depths of the ground by worms. This discovery is rather interesting to English people on account of its association with Mr Darwin's last book, where he showed the curious office that is performed by worms in carrying up deeper portions of the soil to the surface. And here we find the same explanation in France found applicable to the coming up of the poison of diseased animals to the surface to infect the living. Of course, this points out the

lesson that the only effectual way of destroying these bodies is by cremation.

I may say that our practical light at present as to the means of preventing the spread of infectious diseases is as follows—*to avoid filth and to isolate disease.* That comprises the whole practice of the matter. How are we to isolate disease? I may be asked. In Edinburgh the Corporation has recently provided a fever hospital for that purpose, but it is most disappointing to find how little interest the public take in such a step forward, and how little they seem to care about it. We have in this hospital at present the means of affording the poorer classes a ready escape from the dangers of treating these infectious diseases at home. An instance recently came under my notice that shows these dangers. One of the children in a family took scarlet fever. The parents were urged to send off the child to the fever hospital for the sake of protecting the other members of the family and other inhabitants of the common stair. They declined to do so, because as they said the other members of the family had had it already, and therefore they supposed there was no danger to their household, and, as for their neighbours, they might take care of themselves. Now, all their neighbours—wonderful to relate—escaped. But another of their own children took the fever a second time very slightly and died of the secondary effects before an ordinary case would have recovered from the fever. I hope we will have this hospital so arranged as not only to afford this protection from danger to the poorer classes, but also so arranged as to give adequate accommodation for all classes of society. I hope to see wards fitted up so that any of the wealthier citizens may have two or three rooms to which they may bring the sick person, and any member of the family who wishes to nurse him. The patient might be treated by their own medical attendant, with the aid of the house surgeon, who is kept by the town, which would also provide skilled nursing. Here we can provide accommodation, which they could use in an emergency; and they would be saved both the expense and the trouble of making arrangements at home, which are the more difficult to make because of their ignorance as to what should be done. Of course, they would be expected to pay something for these

privileges, and I have no doubt they will be quite willing to do so.

Then, besides having an hospital to which we can carry off a sick person, we also have in this building room for a reception house and refuge for those who are in danger of taking disease from having been in contact with the sick. When a disease of this sort breaks out in a poor family, the proper mode of action, I conceive, would be to capture the whole family, to put the sick member in th fever ward, and to take the others into the reception house, and to watch them, letting them go to their daily work from that house, until we see that there is no risk of their taking the disease, and until we get their own house thoroughly disinfected. When infectious disease breaks out in the house of a wealthy citizen, what happens? Is it not this, that the whole of the children who have not the disease run for their lives to the nearest friend or to a hotel? That being the case, might it not be well to afford them accommodation suitable to their position in this reception house, for which, of course, they would have to pay? But they would have to pay far less for it than they do in a hotel, where the owner would naturally be very chary of receiving them, and if he did receive them, would make them pay accordingly. Now, that something of this sort is very desirable you will at once recognise, when I tell you that last year upwards of 3000 cases of infectious disease were reported to our medical officer of health. There were very nearly 2000 cases of scarlet fever reported in Edinburgh last year, and our accommodation in the Infirmary is for only 74 cases, unless when the disease breaks out to a very large extent, and the corporation steps in and provides fuller accommodation.

It is, I think, perhaps rather an unfortunate circumstance tnat the infirmary should have anything to do with our fever-house arrangements. The infirmary is a charitable institution, whilst the fever-house is not. We ask the citizens to come to it not in charity to themselves, but as a charity to the rest of the community. And the expenses of this accommodation they have already met by paying their rates, so that we may look upon it as a kind of insurance society to which every person pays, and which is, therefore, open and available to all. And another

reason why I think it is a mistake that the infirmary should have to do with these arrangements is this, that those people—and I hope there are not many of them—who shirk their duty and refuse to subscribe to the funds of the Royal Infirmary, in this way get out of their statutory obligation, for the Legislature throws upon every community the expense of the treatment of infectious diseases. If we all contributed to the funds of the Royal Infirmary, it would not matter very much to us whether the treatment was given by that institution or by the Local Authority. But why should those of us who subscribe to the Royal Infirmary be saddled with the expense of the treatment of infectious disease, which is laid by statute upon the rate-payers in general, and others escape without contributing anything for this purpose? I have been told more than once that some people in Edinburgh subscribed to *build* the Royal Infirmary on the distinct understanding that it would, by receiving fever patients, relieve them from their fever rates; in other words, that they paid some of their rates in advance and called it charity, thereby stealing the credit of giving a subscription. Now, I believe, that this is a slander upon the citizens of Edinburgh, who have amply proved that they are unsurpassed in readiness to contribute to public and charitable objects.

THE HUMAN BODY

By D. J. CUNNINGHAM, M.D., F.R.S.E.

"What a piece of work is a man! How noble in reason! how infinite in faculties! in form and moving how express and admirable! in action how like an angel! in apprehension how like a god! the beauty of the world! the paragon of animals!"—Hamlet, Act ii., Scene ii.

I fear that it is an utter impossibility for me in the space of an hour and a quarter, and within the limits of a single lecture, to give you even a general sketch of the structure of the Human Body. Of all the subjects chosen for this session's series of Health Lectures, that which has fallen to my lot is the widest. The utmost that I can hope to do is to call your attention to some of the more important and interesting points in our bodily mechanism. I cannot waste a single word upon introductory platitudes.

When we are set to examine a piece of machinery, our first and most natural question is: For what is it adapted? what kind of work has it to perform? Having learned this, we are in a much better position to understand the parts of the machine, and the manner in which they are related. Thus when we know that a watch is for the purpose of recording time by the regular movements of the hands on the dial, we can appreciate in a much more intelligent manner the arrangement of the main-spring, wheels, and balances which produce the revolution of the hands.

Viewing, therefore, the human body in the light of a machine, let us first enquire what kind of work it does, or, in other words, what functions it performs.

A little reflection will render it apparent to you that we each possess the power of (1) *motion* and *locomotion;* (2) *nutrition, i.e.,*

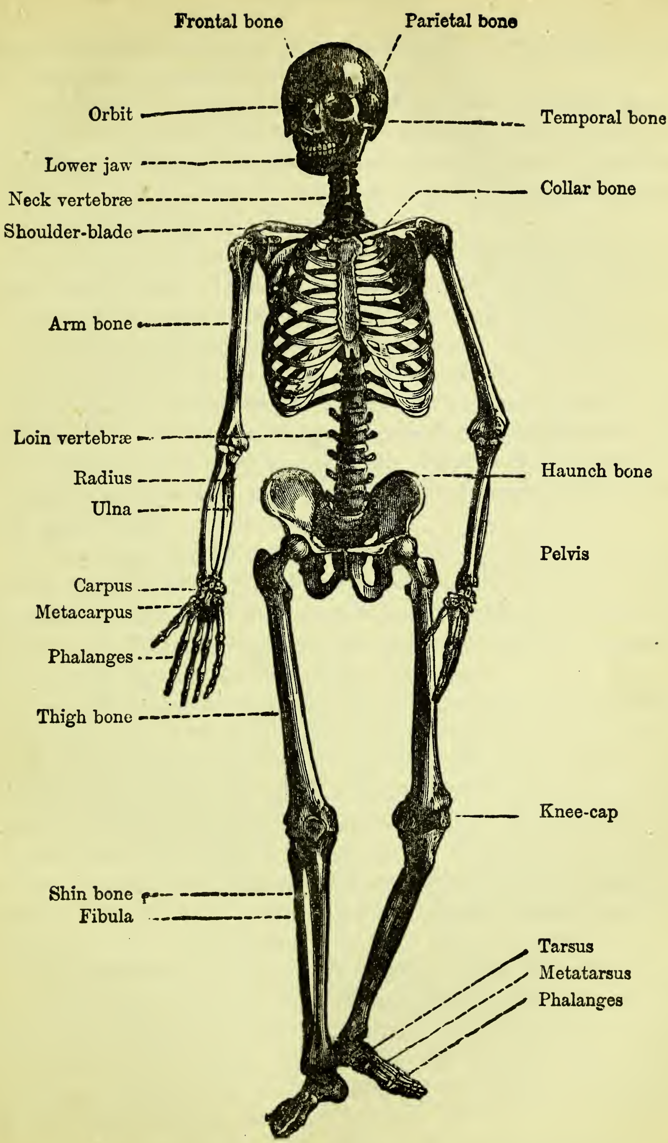
we eat, drink, breathe, perspire, &c., &c.; (3) *innervation*, or the faculty by which we are brought into relation with external objects; (4) *reproduction*, or the means by which the race is perpetuated.

If we descend to the very lowest stage of the animal kingdom and examine the *amoeba*—a very low form of life indeed—we find that it is capable of performing, in some degree at least, all these functions. Imagine a minute drop of the white of an egg, and you have in your mind a tolerably exact model of such an animal. It has little or no structure, and yet by contractions of its body it can move about in a liquid medium. Particles of food sink into its substance very much in the same manner as you would push a marble into a mass of putty—any part of its surface serving the purpose of a mouth. In its interior the nutritious parts of the food are extracted and diffused through the mass, whilst the non-nutritious parts are ejected—any point serving the purpose of a vent. Further, this simple organism has some appreciation of external objects; and lastly, it can reproduce its kind by dividing itself into two or more new individuals, each as vigorous as the original.

As we ascend the ladder, the animals we meet lose this simple condition of body. A principle is at work by which the labour the organism has to undergo becomes divided; coincident with this the organism becomes more complicated. By this I mean that each function seizes, as it were, upon a part of the body and adapts it to its own ends. Thus in the higher vertebrate animals we find a skeleton, joints, and muscles subservient to the function of *motion* and *locomotion;* an alimentary canal, glandular apparatus, circulatory system, lungs, and many other parts devoted to the function of *nutrition;* a nervous system for *innervation;* and special parts for *reproduction.*

Man is one of these higher animals, and the pre-eminence which he claims over other animals is in great part due to the superiority of his nervous system—to the more perfect manner in which he is able to carry on the great function of innervation.

SKELETON.—Here we are then; each of us possessed of a body; each of us capable of carrying this body about with us; and each able to move its various parts the one upon the other. Let us



Frontal bone
Parietal bone
Orbit
Temporal bone
Lower jaw
Neck vertebræ
Collar bone
Shoulder-blade
Arm bone
Loin vertebræ
Haunch bone
Radius
Ulna
Pelvis
Carpus
Metacarpus
Phalanges
Thigh bone
Knee-cap
Shin bone
Fibula
Tarsus
Metatarsus
Phalanges

study the means by which this is performed. This leads me, in the first place, to speak of the skeleton.

The skeleton is the bony framework or scaffolding which supports the soft parts of the body. Entering into its composition, there are about 210 separate bones in the adult. In addition to these the framework is completed at various points by plates and bars of cartilage or gristle.

In our study of the skeleton we classify the bones into three great groups, viz.: (1) those belonging to the trunk; (2) those which form the head or skull; and (3) those of the limbs.

The bony scaffolding of the TRUNK consists of (1) the spine or back-bone, (2) the ribs, and (3) the breast-bone.

Spine or Back-bone.—The back-bone is the great central pillar of the body. On its summit is poised the skull; below it transmits the weight of the body to the lower limbs; whilst laterally it bears the bones of the chest, which in turn support the bones of the upper limbs.

In the *child* the spine is composed of thirty-three separate bones, called *vertebræ,* placed one on the top of the other, but as life advances the lower nine segments amalgamate so to form two bones. In the *adult* therefore we find only twenty-six separate pieces entering into the formation of the spine.

If we take any one of these vertebræ we notice that it consists essentially of a solid cylindrical portion, called the *body,* in front, with a bony arch attached to it behind. The two together constitute a ring large enough to admit the first joint of the forefinger. Next look at the vertebrae in position. The bodies are all superimposed the one on the top of the other so as to form a column, whilst the arches also lie in series so as to constitute a canal. In this canal is placed the spinal marrow carefully protected round and round.

The vertebræ are arranged in groups. The first *seven* belong to the *neck,* and it is an interesting fact that in all mammals (with only three exceptions*) the number of neck vertebrae is seven. It matters not whether we examine the lengthy neck of the giraffe, or the short stunted neck of a pig or a whale; it is always seven—neither more nor less.

* The three-toed sloth, Hoffman's sloth, and the manatee.

The succeeding *twelve* vertebrae bear the ribs and constitute the *dorsal group*, and the *five* following are the *loin vertebræ.* The next *five* vertebrae are welded together into a large triangular bone termed the sacrum, which fits in between the haunch-bones. It is through this bone, therefore, that the weight of the trunk is transmitted to the lower limbs.

It is a popular belief that man has no tail. This is quite a mistake. The sacrum is succeeded by four rudimentary vertebræ usually welded together. These constitute the human tail; but instead of projecting externally, as is customary in the majority of other animals, our caudal appendage is curved forwards in such a manner that we can assume the sitting posture without suffering any inconvenience from it.* The anthropoid apes resemble man in the rudimentary condition of the tail.

But you ask; How are these separate factors of the spine held together? The principal agents in effecting this are a series of tough, elastic, cartilaginous discs interposed between the solid bodies of the vertebræ, and to which the bodies are firmly adherent. They unite the vertebræ in such a manner that whilst the mobility between any two adjacent vertebræ is very slight, the column as a whole possesses great suppleness and flexibility. It can be bent in any direction, and can even be twisted upon itself, as is exemplified every time we look backwards when in the sitting posture.

Have you ever reflected upon what characteristic the high dignity of the body of man depends as compared with that of the lower animals? A little thought will make you see that it is his *erect attitude.* The anthropoid apes, it is true to a certain extent, approach him in this respect, but how shambling, crouching, and half-bent is their gait in comparison with his. The

* Every one has heard the curious story of the "tailed men" of Borneo, who when they wish to sit down have to cut a hole in the ground for the reception of the tail. This story, of course, has always been regarded as a myth, but it is only recently that its origin has been discovered. It has been proved by Mr Bock, in his beautifully illustrated book upon the "Head-hunters of Borneo," that the fable has arisen from the name given to the personal attendants of the Sultan of Passir. They are called "tail-people," which means probably that they follow at the tail of their master (?)

gibbon alone in his progression can dispense with the use of his arms. The chimpanzee, orang, and gorilla when they take to the ground shuffle clumsily along in a semi-erect attitude, using their arms as an aid to their legs. The orang and gorilla have the curious habit of occasionally employing their long arms in the same way as a cripple uses crutches, viz., by placing the knuckles on the ground, and then swinging the body forwards between the arms.

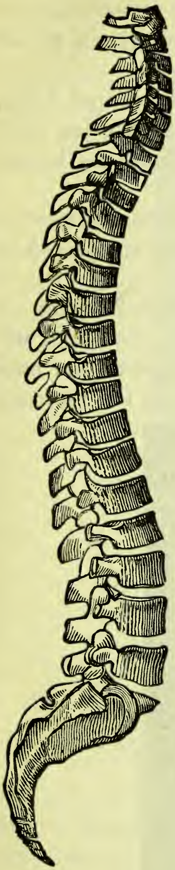


Fig. 1.
Human Spine.

Man alone has attained the perfectly upright posture, and moves freely without the use of his arms; perhaps, however, his tendency to use a walking-stick may be looked upon as a vestige of his former habits!

This important characteristic of man—this erect attitude—is produced by certain graceful and permanent curves in the spine. In the neck the vertebræ bulge forwards; in the back they curve backwards; in the loins they form a convexity forwards; whilst the sacral and tail vertebræ show a convexity backwards. In the man-like apes there is no curve formed by the loin-vertebræ; indeed the only well marked curvature in the spine is that of the sacral and caudal vertebræ. Would it shock those of you who are mothers if I told you that your infants at first present the same characteristics of spine. I mention this not for the purpose of insinuating any relationship between them and the apes, but for the purpose of impressing upon all mothers and nurses the necessity of keeping infants at first as much as possible in the horizontal position, until in fact the child gains strength sufficient to enable it to make efforts at raising itself. The spine then begins to assume those curves so characteristic of man, and so essential to a graceful and dignified bearing.

I cannot pass from this subject without pointing out how beautifully the spine is adapted to prevent jars or shocks to the body. The soft cartilaginous discs between the vertebræ act as cushions or buffers, whilst the curves give a springyness to the column similar to that of a spiral spring.

Chest.—This is the cavity which contains the heart and lungs. Behind, it is bounded by the backbone, viz., that portion of it which is formed by the dorsal vertebræ ; in front, by the breast-bone ; and upon either side by the ribs.

The *breast-bone* is a flat elongated bone which tapers somewhat from above downwards, and which the ancients considered to resemble, in some respects, a sword.

The *ribs* are twelve in number on either side in both sexes. I say in *both sexes,* because I know that the idea is not at all uncommon amongst those unversed in anatomy, that in the male skeleton there is a rib wanting, and that woman is the represen-

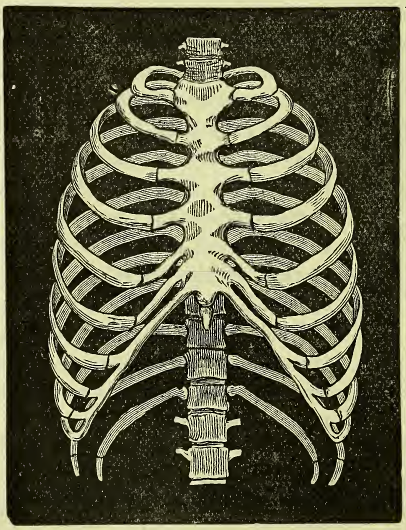


Fig. 2.

Shape of the normal chest.

tative of this missing rib. But this is a popular error. The rib which was abstracted from Adam for the manufacture of Eve has

reappeared in his male descendants. Man, therefore, has been no loser by the transaction, but has recovered his own with usury.

These twelve ribs are attached behind to the sides of the dorsal vertebræ; from the spine they arch forward towards the breast-bone, and as they approach its margin they cease to be

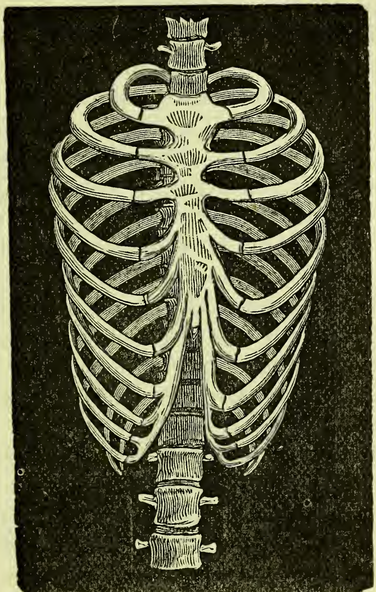


Fig. 3.

Chest of a girl, twenty-three years of age, deformed by tight-lacing. From Rüdinger's work on Human Anatomy. Contrast this with Fig. 2

bony and become cartilaginous. Only the upper seven of these partly bony and partly cartilaginous arches are directly connected to the side of the breast-bone. The succeeding three are fixed in front to the lower border of the seventh, whilst the two last are quite free in front, and are consequently called the *floating* ribs.

This combination of bone and cartilage in the construction of the walls of the chest gives it great elasticity, and contributes very materially to its strength and its capability of sustaining heavy blows without injury.

Let us now examine the shape of the chest-cavity. The chest

is a barrel-shaped cavity distinctly conical in form; above it is narrow, but it gradually widens out, so that below it attains a very considerable width.

Such is the shape which nature has given the chest, but in modern civilized countries women endeavour to improve upon nature by the use of stays or corsets. This dressmaker's block shows what the conventional idea of a beautiful female figure is, and *nolens volens* nature must be moulded after this pattern. Compare this block with the magnificent outline of the Venus of Milo*—this fine copy of which I am able to show you through the kindness of Sir John Steell. Observe the difference. By all anatomists this statue is considered the very type of female grace and beauty, and for this simple reason, that it represents truthfully the natural female form in its highest perfection.

But so utterly depraved is the popular taste in this respect that I feel I must give more practical and more cogent reasons why stays should be abolished as articles of dress; and I confess I am ambitious of working some reformation in modern dressmaking. These diagrams show the structural deformity of the chest which tight-lacing produces. The chest is no longer conical (*i.e.*, narrow above and wide below), but it has assumed the shape of the stays and is shaped like an egg with the large end uppermost (Fig. 3, p. 29). Lateral curvature of the spine to a greater or less extent is a very frequent accompaniment of this, and the right shoulder is generally rendered higher than the left.

To understand the full enormity of this deforming practice we must examine the effect it has upon internal organs. Stretching across the lower end of the chest-cavity is a thin muscular partition which separates it from the cavity of the abdomen. This partition is called the *midriff* or diaphragm. It is dome-shaped, forming a highly convex floor for the chest and a vaulted roof for the abdomen. Within the chest, as I have already said, are the

* Prof. Flower in his little volume entitled "Fashion in deformity" places with marked effect two woodcuts, side by side, viz., an outline figure of the Venus of Milo and a lady dressed according to the present Parisian fashion. A still greater contrast is obtained by placing a dressmaker's block by the side of the statue.

heart and lungs. These are accurately adapted to the upper surface of this partition. Moulded to the under surface of the

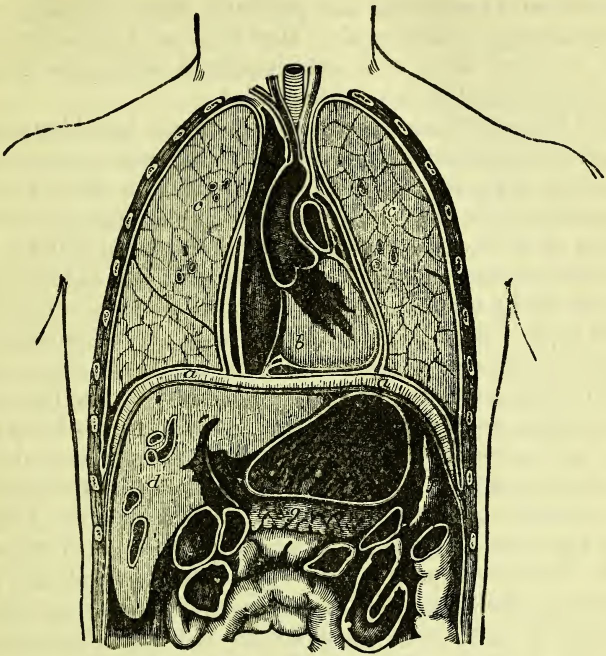


Fig. 4.

Section through the chest and abdomen. (*a*) diaphragm; (*c. c.*) lungs; (*b*) heart; (*d*) liver (*e*) stomach; (*f*) spleen. (Modified from Luschka's Anatomy by Prof. Cleland).

diaphragm is the liver—the bulk of which, however, lies upon the right side of the body. Towards the left side both the spleen and stomach are also in contact with the under surface of the diaphragm. Now the distortion produced by tight stays has mainly two evil effects—(1) it dislodges these organs from their natural position, and (2) it restricts the breathing power. The liver suffers most. Its surface is sometimes deeply indented by the ribs*—sometimes indeed it is driven downwards so as to leave, in

* It is right to state, however, that Prof. Turner looks upon such furrows as congenital, and produced by certain of the ribs lying upon a deeper plane than the others. He has seen the indentations "almost as frequently in men as in women."

great part, the shelter of the ribs. It has even been found so low in the abdominal cavity as to be resting upon the haunch-bone. The stomach also is compressed and prevented from expanding sufficiently during and after meals. How then can digestion be properly executed when two such important accessories to the process are treated in this cruel fashion ?

But I have said that tight-lacing restricts the breathing power. The act of breathing is produced by the alternate increase and diminution of the capacity of the chest. This is effected by (1) movements of the chest walls, and (2) by the alternate descent and rise of its floor, *i.e.*, the diaphragm. But the walls of the chest when encased in tight stays are bound down so firmly that they can hardly move, and consequently the diaphragm has to do all the work. Now this is the very form of breathing for which women, as compared with men, are worst fitted, and which under certain conditions becomes next to impossible.* The lungs also are so compressed that the blood and air cannot pass freely into them, and the result is that the blood is imperfectly aerated.

We boast greatly of our high civilisation; we are appalled when we hear that it is the custom of certain barbarous tribes to compress, by means of bandages, the heads of their children so as to give them the shape of a sugar-loaf. I would simply ask you, are we one whit better when we systematically distort our chests ? My belief is that we are worse, because it has not been proved that the compression of the head leaves much evil effect behind,† whilst by distorting the chest we interfere with the most important vital functions of the body.

When I am on the subject of female dress I may as well say that the tendency of the present fashions appears to be to restrain the free movement of almost every part of the body. The Mother Hubbard and Dolman cloaks pin the arms down to the already compressed chest, whilst the skirt of the dress is so tightly tied in behind the knees that only a very limited degree of movement is allowed at the hip-joints. With chest, arms, and

* Pregnancy.

† Up to a comparatively recent period, French mothers, in certain districts, were in the habit of compressing the heads of their infants by bandages. In these cases very evil consequences sometimes resulted.

legs bound up in this manner, like Egyptian mummies in their swathing bands or fowls trussed for the table, the only parts of the body which can move freely are the head and the lower-jaw. How can women expect to be healthy when they neglect one of Nature's great laws, viz., free exercise.

But I fancy I hear you say, "Is this not too sweeping a condemnation? it is only a certain proportion of the sex which lace tightly and wear such apparel." I am quite willing to grant this, but there are very few women indeed who dispense with stays altogether, and however loosely these may be applied they give an artificial support to the spine, and thus detract from its inherent strength. Stays act exactly in the same way as a prop to a tree. It is a well known fact that whenever a tree becomes accustomed to the support of a prop it generally ceases to take strong hold upon the ground with its roots; it in fact relies upon the prop for its support. In like manner the stays weaken the spine. If a corset must be worn, then let it be one with no bones but composed of soft material quilted or corded.

Skull.—Twenty-two bones enter into the formation of the skull, and these, with the single exception of the lower-jaw, are so firmly united the one to the other that little or no movement can take place between them.

The skull consists of two parts: (1) a portion belonging to the face, and (2) a capacious cavity termed the cranium or brain-case, which is developed for the purpose of protecting the brain.

The bones of the face are *fourteen* in number. They are placed below the forehead, and they are so arranged that they take part in the formation of the walls of the orbits—two deep recesses or sockets in which the eye-balls are lodged—the nasal cavities and the walls of the mouth.

In the lower animals the facial bones are prolonged forwards so as to form a projecting muzzle, which in great part lies in front of the cranium or brain-case. In man the facial bones lie almost entirely under cover of the cranium, and it is only in some of the lower races of mankind, as, for example, the native Australians and Negroes, that we observe a slight tendency to the projection of the jaws. This is a very beautiful provision of Nature. In the lower animals the fore limbs are organs of pro-

gression, and the jaws are prolonged forwards to act as organs of prehension. By them the animal is enabled to obtain its food. The prehensile arms of man render such a provision unnecessary.

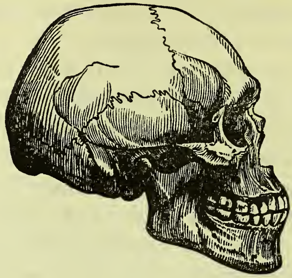


Fig. 5.
Skull of a native Australian (Carpenter)

The *eight bones* of the cranium are united to each other by their margins, and so firmly are they interlocked the one with the other that no individual bone can be removed without breaking up the whole fabric. When we wish to do this it is necessary to apply the force from within by filling the cavity with peas. These when moistened expand and break up the brain-case into its constituent bones. This shows how admirably it is adapted to withstand injury from without.

Taking a skull in our hand and turning its lower surface towards us we observe that its base is perforated every here and there by apertures. These holes are for the purpose of transmitting nerves and bloodvessels to and from the brain. One very large oval opening, called the *foramen magnum*, at once attracts our attention. It is situated just behind the middle point of the base of the skull, and when we place the skull in position upon the top of the spine, we notice that the foramen magnum lies immediately over the spinal canal. This hole, therefore, is the aperture through which the brain is continuous with the spinal marrow.

Upon either side of the fore part of the foramen magnum there is a small elevated smooth convex surface. These fit into corresponding sockets in the first vertebra, and in this way the head is poised upon the summit of the back-bone. In the lower animals

these surfaces are placed much further back, but the erect attitude of man necessitates that they should be placed near the middle point of the base of the skull, so as to balance the head and prevent it pitching forward.

The form of the cranium is subject to considerable variation; indeed it is recognised by anatomists as being one of the best means of distinguishing the different races of man. We are in the habit of separating skulls into three groups, viz.: (1) *long-headed,* those which are very long as compared with their breadth; (2) *short-headed, i.e.,* those which are very short as compared with their breath; and (3) *medium-headed,* those which have a medium length and breadth, or those which occupy an intermediate position between the two extremes.

The negroes and aboriginal Australians are, as a rule, *long-headed;* the North American Indians are *short-headed;* whilst the inhabitants of Central Europe are for the most part *middle-headed.* The French are said to possess the most typical medium skulls. The form of the skull, however, cannot of itself be considered a sufficient indication of the intellectual powers of the individual. If this were the case, the French nation would perhaps occupy the highest position. A still more important factor to be taken into account is the capacity of the brain-case. As the cranium is completely filled with the brain, we can, by measuring its capacity, form an accurate estimate of the size of the brain which occupied it. Here again there are considerable differences in the skulls of different races. The European brain-case is considerably the largest, having an average capacity of about 91 c. inches; the average capacity of the Negro cranium, on the other hand, is only 85 c. inches, whilst that of the aboriginal Australian is as low as 79 c. inches.

But what a prodigious difference we find between the cranial capacity of man and that of the ape! Of all the points which distinguish man from his nearest of kin in the animal world this is the most striking. Speaking generally we may assert that the lowest cranial capacity which has been noticed in man is twice as great as that of the highest cranial capacity that has been noticed in the gorilla.

The next fact which I have to mention in connection with this

subject is one which I fear will not meet with the approval of the fair sex. But it is a fact which I cannot suppress, viz., that the cranial capacity of the male skull is usually greater than that of the female skull. The average British male cranium has a capacity of 90 to 95 c. incles; the average British female cranium a capacity of 80 to 90 c. inches. The interesting point in connection with this is that there seems to be a greater difference in this respect between the two sexes of the higher races than between the two sexes of the lower races, as say between the negro and negress. If this statement be true (for it still requires to be verified), it would appear that civilisation causes a greater advance in men than in women. Carl Vogt explains this by pointing out that in low races such as the Australians and Bushmen, which possess no fixed habitations, "the wife partakes of all her husband's toils, and has, in addition, the care of the progeny."

The investigations of Paul Broca seem to point to the probability that the advance of civilisation in a people is accompanied by a slow increase in the cranial capacity. He had an opportunity of examining a large number of skulls of the Parisians who lived in the twelfth century. On comparing these with the skulls of the more modern Parisian population, he found that they had a decidedly smaller capacity.*

* A discussion is going on at present in "Nature" regarding "an alleged diminution of men's heads." It seems that there is a prevalent belief amongst hatters that a diminution has taken place. A hatter who has been in business for a great number of years compares the ratio at which hats were purchased 35 years ago with the ratio at which he is at present selling them, with the following result:—

Size in Inches.	Relative Number of Each Bought	
	Thirty-five Years Ago.	At Present.
21	0	3
21½	1	4
22	2	3
22½	4	1
23	3	1
23½	1	0

Professor Flower, who is perhaps the most eminent craniologist in this country, rightly refuses to receive "a fact so contrary to all theory and to all experience" until more exact and more extensive data are produced.

Limbs.—At the commencement of my lecture I explained to you the principle which leads to the complexity of the animal body, viz., the principle of the division of labour. Now it has been established as a law by Milne Edwards, that the more completely this principle is carried out in an animal the more perfect is its mechanism. In a quadruped, such as the horse, all the four limbs are used for progression, and nothing else, save perhaps defence. The jaws are prolonged forward so as enable the animal to seize and obtain its food. Ascending some steps in the animal kingdom we come to the apes. In these the four limbs are still employed as instruments of locomotion, but each is in addition prehensile. Each, therefore, is endowed with a double function. The jaws are not nearly so prominent, and play but an inferior part to the limbs in the securing of sustenance. In man a still greater difference is found. The lower limbs are framed for locomotion alone, and assume the entire duty of conveying the body from place to place. The arms thus freed from this inferior work are devoted solely to prehension, and become the faithful ministers of the mind. The jaws also have retreated so as to lie altogether under the cranium, and the only function allotted to them is the trituration of the food. The three functions, therefore, of locomotion, prehension, and the trituration of the food which are distributed over the four limbs, and the jaws in the quadruped and the ape, are in man each performed by its own instrument—the labour is thus divided, and man in consequence presents a more perfect organism. But you may ask what advantage is gained by this arrangement? I will answer this Scotch fashion by putting another question. Whether is it better to have in a house three general servants, or three servants—one a trained cook, another a trained housemaid, and the third a trained tablemaid? Am I not right in supposing that the work will be better done by the latter than by the former. The case is quite the same with the human body.

The lower limbs of man then are entirely devoted to locomotion, and in consequence of this they possess a length and a development far beyond that of the most man-like ape. The prehensile upper limbs, on the other hand, are not nearly so power-

ful, and are very much shorter. In the European, when the body is erect the middle finger cannot reach lower down than the middle of the thigh ; in the negro it reaches a little lower. The orang when erect can touch his ankle with his fingers ; the gorilla can touch the middle of his leg, and the chimpanzee his knee.

Let us now, very briefly, look at some points in the construction of the limbs.

In the *lower limb* we recognise a haunch, thigh, leg, and foot. The skeleton is composed of the following bones :—(1) The haunch-bone ; (2) the thigh-bone ; (3) the knee-cap ; (4) the two bones of the leg ; and (5) the bones of the foot.

The *haunch-bones* of opposite sides are firmly jointed together in front. Behind, the sacrum—which you will remember is a bone formed by five of the lower vertebræ, welded together—fits in between them like the key-stone of an arch. The weight of the body is thus transmitted to the lower limbs, and at the same time a cavity is formed which is termed the *pelvis*, so called because it resembles a basin.

The upper portions of the haunch-bones are widely expanded. By this character the haunch-bone of man can be distinguished from that of all other animals. The expansion is rendered necessary by the erect posture of the human body, and it is developed for the purpose of giving support to the intestines. In quadrupeds the weight of the bowels is sustained by the flaccid lower wall of the abdomen, and this is strengthened for the work in large animals, such as the horse, by a powerful elastic tunic, which not only prevents relaxation of the abdominal wall, but also by its elasticity guards the viscera against shocks.

The *thigh-bone* is the longest and most massive bone in the body. Its upper end presents a smooth globular head which fits into a deep cup-like socket upon the side of the haunch-bone, and forms the hip-joint. This rounded smooth head of the thigh-bone is not placed upon its very extremity, but is separated from the shaft of the bone by a constricted neck which joins the shaft at an angle. By this means a much wider range of movement is allowed at the hip-joint.

At this stage I must say a word or two upon *joints*. I will not speak of the immovable joints, such as those between the bones

of the skull where the junction is effected by the interlocking of toothed margins. Nor will time permit of my describing to you the partially movable joints such as those between the two haunch-bones in front and between these bones and the sacrum behind. I will simply direct your attention to a few leading points in connection with the truly movable joints, such as we find between the bones of the limbs.

In such joints the opposed surfaces of the bones are each coated with a thin layer of exceedingly smooth elastic cartilage or gristle. This acts in precisely the same manner as the buffers of a railway

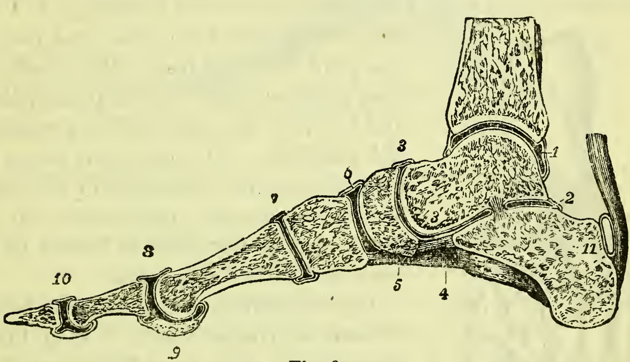


Fig. 6.
Section through right foot, from centre of heel to tip of the great-toe, to show the joints (Quain.)

carriage. When you reflect then that in these joints every bone is separated from its neighbour by two such layers, you will understand the high elasticity and springyness which, by this means alone, is given to the skeleton, and how we are able to carry our bodies about with us with so little inconvenience from external shocks and jars.

Binding the bones together at a joint there are a series of strong membranous bands called ligaments. One of these is usually placed upon each of its four aspects, and they are frequently converted into a continuous and unbroken ligamentous envelope or capsule for the joint by intermediate and thinner membrane which passes between their margins.

A third and very important element in the formation of such a joint is an exceedingly thin membrane called the *synovial*

membrane, which lines the inner surface of the ligaments. It presents a polished glistening surface, from which exudes a viscid fluid—the joint oil. This lubricates the interior of the joint, and allows the cartilage covered ends of the bones to glide smoothly upon each other.

The two bones of the leg lie side by side. They are (1) *shin-bone* on the inside, and (2) the *fibula* upon the outside. The shin-bone is a heavy massive bone, which receives from the thigh-bone the entire weight of the body. The fibula does not reach so far up as to take part in the formation of the knee-joint. The *knee-cap* is a bone with which you are all familiar. It forms the prominence of the knee, and protects the joint from the front. The fibula is a long slender bone, which is jointed above and below to the upper and lower ends of the shin-bone. Its lower end forms the projection on the outer side of the ankle. The corresponding prominence on the inner side of the ankle is formed by the lower end of the shin-bone.

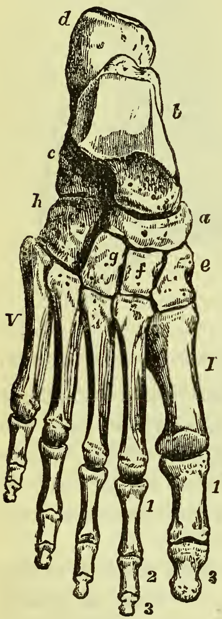


Fig. 7.

a, b, c, d, e, f, g, h bones of tarsus; i to v bones of metatarsus; 1, 2, 3 phalanges of great and second toes (Quain).

The mechanism of the foot is so beautiful and so characteristic of man that I must dwell a little more fully upon it.

There are *twenty-six* bones in the human foot. Of these the hinder *seven* are short and stout, and constitute what anatomists call the *tarsus, i.e.,* the back part of the instep. In front of the tarsus there are *five* prismatic bones, which are jointed to it, and which lie side by side. These are termed the *metatarsus,* and they form the front part of the instep. The anterior rounded ends of the five bones of the metatarsus rest upon the ground, and are popularly known as the balls of the toes. Each metatarsal bone supports a toe, and each toe, with the exception of the great toe, is formed by three bones placed end to end. The great toe has only two

such bones. The toe bones are called phalanges, from being placed in rows like soldiers in a phalanx.

The seven bones of the tarsus, together with the five bones of the metatarsus, constitute an arch, termed the *plantar arch,* the height and span of which is greater upon the inner than upon the outer aspect of the foot. The key-stone of this arch is formed by the

Fig. 8.
Section through foot, from centre of heel to tip of great toe, to show the plantar arch. *See* also Fig. 6.

highest of the tarsal bones—a bone called the *astragalus* (fig. 7, *b*), This bone supports the entire weight of the body, being clasped between the inner and outer ankles, and it transmits its burden to the summit of the arch. The hinder pillar or pier of the arch is formed by one bone, viz., the heel-bone, which is the largest of the tarsal bones, whilst the anterior or front pillar is formed by several bones. In consequence of this the anterior pillar is highly elastic, and the posterior pillar almost rigid, and therefore, when we jump from a height, we make it an invariable rule to descend upon the balls of the toes, and thus break the shock which we would receive were we to land first upon the rigid heels.

The bones of the plantar arch are held together by dense ligaments. Of these two are specially important for maintaining the arch of the foot. One is a powerful and non-elastic brace, which stretches between the extremities of the pillars, viz., from the under surface of the heel-bone to the balls of the toes (Fig. 8). This ligament, as Professor Humphry has pointed out, acts in precisely the same manner as the tie-beam of a roof. It prevents the pillars of the arch from being pressed too far

apart when the weight of the body, and anything it may be carrying, is transmitted to the foot. The other ligament, I wish to refer to, is highly elastic—just like an indiarubber band. It passes between the heel-bone and one of the tarsal bones which lies in front of it, and the rounded end of the astragalus or key-bone rests upon it (Figs. 6 and 8). When the weight of the body is thrown on the astragalus this ligament gives by virtue of its elasticity, and the key-bone sinks. When the weight is removed the ligament recovers itself, and restores the bone to its former position. The foot therefore gains greatly in elasticity by the presence of this ligament, but it will be easily seen that this gain gives rise to a weak point in the *plantar arch.* In people with weakly constitutions, or when the foot is subjected to great and continuous strains, as in ballet dancers, or bakers who carry heavy loads of bread upon the head, this ligament may become relaxed, and the result is that deformity of the foot which we all know as "flat foot." This then consists in a destruction of the plantar arch by the descent of the astragalus.

The foot of man is one of the great structural distinctions of the human species. In none of the apes have we a perfect plantar arch, and in none have we so great a development of the great-toe. In man the great-toe possesses a very small range of movement; in the apes it is highly mobile, and resembles in this respect the thumb of our own hand. We must not forget, however, that the capabilities of our foot are greatly interfered with from its being encased in a boot. Every one has noticed the wide range of movement possessed by the toes of an infant. Further, it is a well known fact that in bare-footed people the toes may attain a considerable amount of grasping power. Thus the Australian natives can lift their spears by the foot; the Chinese boatmen can pull an oar; and the natives of Bengal can weave. Not very long ago in Belgium, a gentleman who had been born without arms attained distinction as an artist by wielding the brush with his feet.

We have seen how cruelly fashion deals with the female waist. It is almost as cruel to the foot. An immense amount of pain and misery lies at the door of the shoemaker—corns, bunions, in-growing toe-nails—and all because a boot made according to

the true shape of the foot is considered to be clumsy and inelegant.

Let me point out to you what the true shape of the human foot is. I need not ask you to look at your own feet in illustration of this. Thanks to your shoemakers,* I don't believe that there is a foot in this hall which is quite free from deformity. We must examine feet which are altogether unacquainted with shoe-leather, such as those of an infant or a bare-footed urchin. In such a foot we notice that the toes are widely spread out, and that the great toe stands free from the others. If we draw a line from the centre of the heel along the sole to the extremity of the

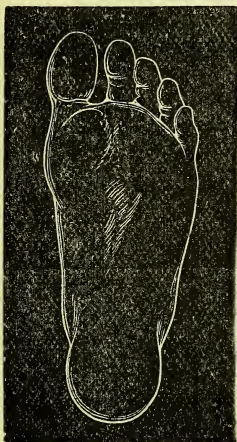


Fig. 9.
Natural foot.

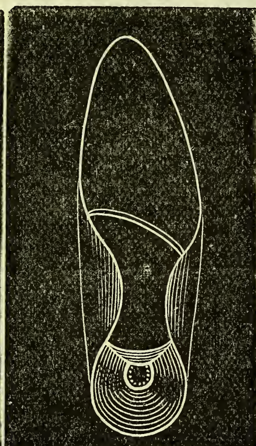


Fig. 10.
Outline of the sole of an ordinary boot.

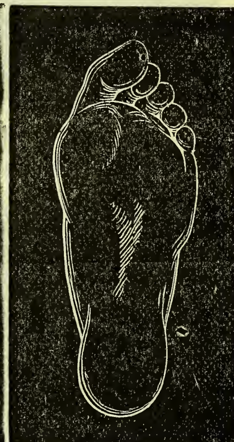


Fig. 11.
The common condition in which feet are found. Great toe deflected outwards.

middle toe, and another backwards through the middle of the great-toe, the axis of the great-toe is seen to be parallel with that of the foot. How different is the shape of that part of the ordinary boot which encases the toes. The sole is pared away on each side so as to make it pointed in front, or, as Mr Dowie has remarked, as if "a great-toe was in the middle and a

* Of late years shoemakers have been paying more attention to the shape of the foot, but there is still a very great need for reformation in this respect.

little toe on each side like the foot of a goose." In consequence of this the toes are crushed together to such an extent that it is not at all uncommon to find one or more thrust upwards or downwards to make room for the others. The great-toe is deflected outwards, so that its direction is no longer straight but oblique. This is harsh treatment for that member which, above all others, we should prize, seeing that it constitutes one of the chief structural distinctions between the human foot and that of the ape. But this is not the worst feature of the case. In walking, running, and jumping the great-toe is the chief agent in the foot for giving to the body the final push as the foot is being lifted from the ground. By looking at these diagrams you will understand how much its action is weakened in this respect when it is forced outwards by a pointed boot.

Fig. 12.
A sketch obtained from the deformed foot of a woman only two days before this lecture was delivered.

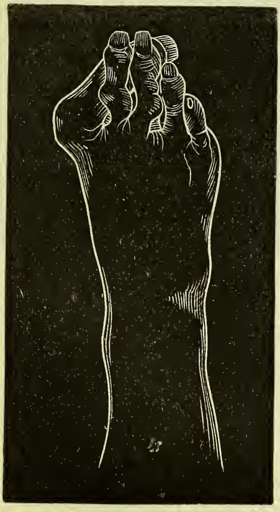


Fig. 13.
Same foot as in Fig. 12,

Had time permitted I would have liked much to have pointed out how the present conventional boot might be improved in its shape. I must simply refer you for information on this to a little pamphlet called "Why the Shoe Pinches," by Professor Meyer.

I must not leave this subject, however, without entering a strong protest against the high narrow heels which usually adorn the fashionable ladies' boot. I have had this diagram prepared in order to show you some of the consequences resulting from these.

The plantar arch is distorted ; the posterior pillar or heel-bone is so raised that the weight of the body is not distributed equally over the arch but is thrown mainly upon the anterior pillar. In

Fig. 14.
Outline of modern ladies' boot.

order to maintain the equilibrium of the body, the knee has to be kept slightly bent, and the invariable result is a wasting of the muscles of the calf, and a weakening of the whole limb. But this is not all. The heel-piece is seldom placed directly under the heel-bone or posterior pillar of the plantar arch. In great part it presses directly upwards against the tie-beam ligament of the foot into the hollow of the arch. Now in this hollow are placed the blood-vessels of the foot, and they are placed there for the purpose of escaping pressure when the foot rests on the ground. By the high heel this provision of nature is defeated, the circulation is interfered with, and the results are cold feet, and in winter a proneness to chilblains. Why should ladies simulate a practice which they ridicule so much in Chinese women ?

In the *upper limb* we recognise a *shoulder*, an *arm*, a *forearm*, and a *hand*.

Entering into the construction of the shoulder there are two bones—the collar-bone and the shoulder-blade. Together these constitute a part of the skeleton which we are in the habit of

calling the *shoulder-girdle,* seeing that it partially encircles the upper part of the chest on either side.

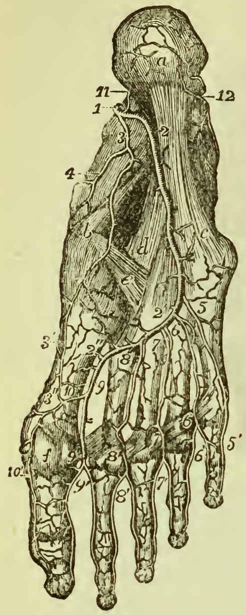


Fig. 15.

Sole of the foot dissected to show the bloodvessels. 1, 2, 3 main arteries of the foot (Teidemann).

The *collar-bone* stretches from the upper end of the breast-bone to the shoulder-blade, to both of which it is firmly jointed.

We have to thank the collar-bone for the wide range of movement which we possess at the shoulder-joint. It acts as a prop to keep the shoulders apart, and in those animals in which it is absent, as, for example, the horse and the ox, the limb can only be moved backwards and forwards. The advantage which is thus gained by the shoulder of man is attended with some risk. The projection of the shoulders renders them very liable to injury. Indeed, fracture of the collar-bone, and bruises and dislocation of the shoulder-joint, are about the commonest injuries that come under the notice of the surgeon.

I don't think that we would readily admit any superiority of carriage in French women as compared with the women of our own country. Still it has been asserted that in the former the collar-bones are slightly longer, and that they are thereby enabled to carry themselves with more grace.

The *shoulder-blade* is a flat triangular bone which lies upon the back of the upper part of the chest. At no point is it directly jointed to the bones of the trunk. Indeed, the only direct articulation between the upper limb and the trunk is where the collar-bone is jointed to the breast-bone.

In the upper-arm there is a single long bone—the *arm-bone* or *humerus.* The rounded upper end of the arm-bone rolls in a hallow concavity or socket which is developed on the upper and outer angle of the shoulder-blade.

In the forearm we find two bones placed side by side and extending from the elbow to the wrist. Of these the outer is termed the *radius*, and the inner the *ulna*. At the elbow-joint the ulna is very extensively connected with the arm-bone or humerus; indeed it holds the lower end of the latter in a deep crescentic concavity. The upper end of the radius is very small, somewhat disc-shaped, and in contact with the lower end of the humerus by its upper surface alone. If we now compare the lower ends of the bones of the forearm, we notice that the lower extremity of the radius is broad and expanded, and takes the chief part in supporting the hand, whilst the lower end of the ulna is small and button-shaped, and is separated from the bones of the wrist by a triangular piece of cartilage or gristle. Whilst then the ulna has a greater share in the construction of the elbow joint, the radius predominates at the wrist joint.

Now the radius, with the hand which is fixed to its lower end, is capable of performing two very important movements. These movements are termed *pronation* and *supination*. I have said that the radius lies to the outer side and parallel with the ulna. When the bones have this relative position the arm is *supine*. This is the position which is assumed when we lay the back of the hand upon a table so that the palm looks upwards. Reversing the attitude, however, and placing the palm of the hand upon the table, we produce *pronation* of the limb. The relative position of the two bones of the forearm is now altered. The upper end of the radius still lies upon the outer side of the ulna, but the large lower end of the radius with the attached hand has rolled over the small button-shaped lower end of the ulna, so as to lie upon its inner side. The two bones in this condition cross each other like the limbs of the letter X.

In the hand there are three segments, viz., the wrist, the palm, and the fingers.

Entering into the formation of the wrist there are eight small bones, called *carpal* bones, arranged in two rows—four bones in each row. These are so accurately fitted the one to the other and are so firmly bound together by ligaments that it is very rare indeed to find them displaced by an injury.

The soft parts of the palm are supported by five prismatic bones

called *metacarpal* or knuckle bones. These are placed side by side, and are jointed above to the lower row of carpal bones. Each knuckle bone is succeeded by the bones of a finger, which like the corresponding bones of the toes are called phalanges. The inner four fingers have each three phalanges, whilst the thumb has only two.

The hand of man is essentially a grasping instrument, and its high capabilities in this respect are due to the great mobility of the thumb, and the power by which this digit can cross the palm so as to touch the tips of all the other fingers. So important is the hand to the well-being of man that there are some who consider the high mental superiority which man shows over all the lower animals, in great measure due to his being the possessor of so perfect a prehensile organ. Whether this be the case or not, it is at least certain that the mind and the hand are mutually dependent. What use would the mind be to us for inventive purposes had we not the hands to carry out the invention to its practical results.

The ape alone amongst the lower animals can imitate the movements of the human hand, and this very imperfectly. Throw a nut to a monkey and he will pick it up—not between the tips of the fore-finger and thumb—but between the thumb and the side of the bent fore-finger. In many respects the hand of the ape is inferior: thus the thumb is shorter and less mobile; the fingers cannot be so widely separated; and there is little or no power of making the "hollow of the hand."

Muscular System.—I have now given you a very brief and I fear a very inadequate account of the bony-scaffolding of man. We must next consider the means by which this is maintained in the erect attitude; how it is that its various parts are moved the one upon the other; and how it is that the skeleton as a whole moves from place to place. All this is due to the *Muscular System;* not the smallest twitch of an eyelid—not the slightest change in facial expression can be affected except through the agency of *muscles.*

The muscles constitute the red flesh, or what is perhaps better known as the "lean" of the body. There are somewhere about 400 muscles in the human subject. Everyone has seen a leg of

mutton cut across the middle, and has observed the red flesh around the bone. No doubt you have also noticed that this red

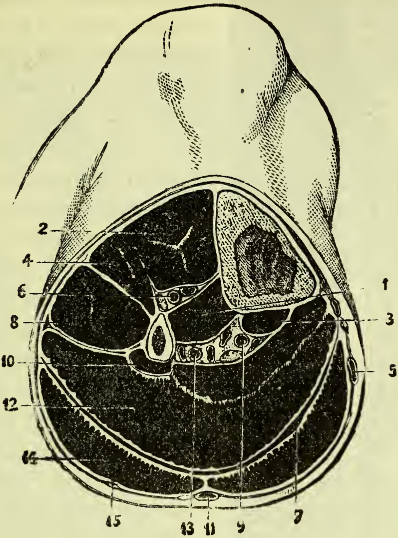


Fig. 16.

Section through leg, 1, 2, 3, 8, 10, 12, 14 various muscles; 9, 13, 11, 6, and 5 bloodvessels, The larger bone is the shin-bone, and the smaller the fibula (Heath).

flesh does not constitute a uniform mass, but is sub-divided into unequal variously shaped areas by white lines, representing fibrous partitions. Now each of these areas represents a separate muscle, and if, in a limb before it has been detached from the body, you were to follow this muscle by dissection upwards and downwards, you would find that the fleshy mass ends at either extremity in a sinew or tendon; and further, that by these sinews it is attached firmly to the skeleton. Understand this, however, that the upper and lower tendons of a muscle are never attached to the same bone, but always to different bones.*

* I refer here to the majority of the muscles. There are some which are attached only by one end to the skeleton, such as those which move the eyeballs and the skin of the face ; a few, indeed, can hardly be said to have any attachment to the skeleton, as, for example, a little muscle on the inner side of the palm, which wrinkles the skin and deepens the hollow of the hand.

In the human body, then, we have this enormous number of muscles passing from bone to bone, clothing them and connecting them together. But how, you ask, do they produce the movements of the body? They perform this by their power of contracting; every muscle is capable of shortening itself, and thus approximating its terminal tendons and the bones to which these are fixed. The tendons have no contractile power. They act therefore just like the traces which connect the horse to the cart —they play a passive part.

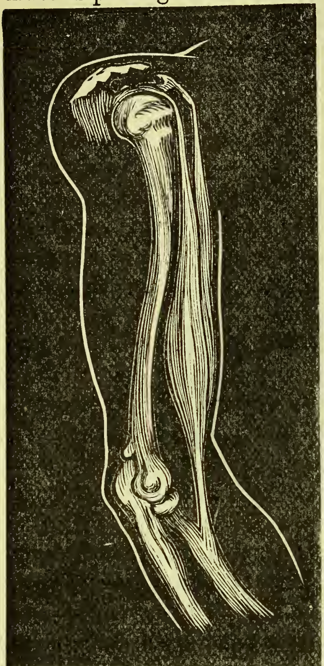


Fig. 17
Forearm extended, Biceps muscle relaxed and at rest.

Let me illustrate this to you by taking one muscle as an example. I will choose for this purpose one with which you are all familiar, viz., the *biceps*. This muscle, as you know, forms the projecting mass in front of the joint of the upper arm, where the limb is bent forcibly at the elbow joint. Above it is attached by two separate tendons or heads (hence its name biceps) to the shoulder-blade; below it is fixed by a cord-like sinew to the radius or outer of the two bones of the forearm a short distance below the elbow. When it contracts, it bends the forearm at the elbow, like a door upon a hinge; and as the contraction of a muscle is always accompanied by a corresponding thickening, or increase in breadth, we have a marked prominence produced in front of the arm.

For the performance of voluntary motion, something more is required than the mere muscles. Each muscle must be brought under the influence of the nervous system; therefore entering it we always find one or more nerves. These nerves connect the various muscles with the brain and spinal marrow, and by them

the movements of the body are excited and controlled. The influence of the nervous system in this respect is manifested by the effects produced by intoxication, or by the disastrous results fol-

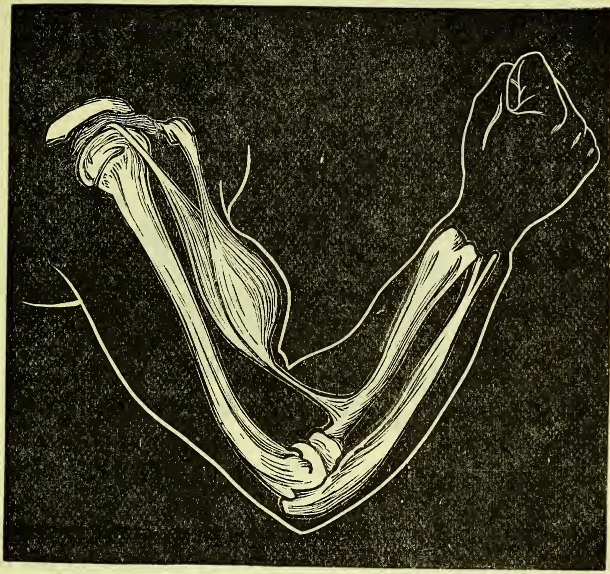


Fig. 18.
Forearm flexed at the elbow joint. Biceps in contracted condition.

lowing apoplexy. The tottering gait and the double vision of the drunkard are caused by the alcohol acting upon the nervous system in such a manner that it is rendered incapable of producing harmonious contractions of the muscles. The sudden collapse of the frame, when apoplexy occurs, is due to a destruction of brain-matter from the rupture of a small bloodvessel, and the pouring out of the blood into its substance.

In addition to the nerves, each muscle is entered by blood-vessels—arteries to carry blood to the muscle, and veins to drain it away. The blood supplies the muscle with the energy requisite for its proper contraction.

Before I finish, let me urge upon you the necessity of exercising

the various muscles of the body. Allow a muscle or a limb to lie unemployed, and it shrinks and wastes. A good physique and a graceful bearing can only be acquired by giving each part of the body its proper amount of regular exercise. But exercise is of

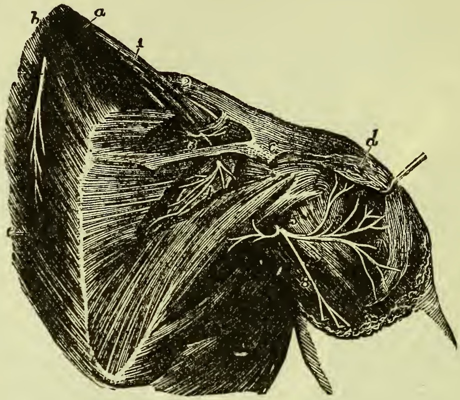


Fig. 19.
Nerves entering muscles of shoulder (Hirschfeld and Leviellé).

value not only for the muscular and skeletal systems—it is an essential for the right performance of every function in the body.

I am now finished. I have confined myself almost entirely to bones and muscles. Dr Tuke will introduce the brain into the cranial cavity. Dr Jamieson will clothe the body with its protective covering, the skin, and Dr Foulis will fill the cavity of the abdomen with the organs of digestion. Last session the contents of the chest cavity were fully described to you.

PARASITES,

IN THEIR RELATION TO FOOD AND HEALTH.

WITH ILLUSTRATIONS.

By Dr ANDREW WILSON, F.R.S.E., F.L.S., &c.,

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Mr Chairman, Ladies, and Gentlemen,—There can exist no doubt that the idea which is evoked by the term parasite is anything but an agreeable one. For, if we even look at the name as it has been metaphorically applied to certain individuals of the human species, we shall find that the term indicates a cringing, despicable unit of humanity, who, as in the days of ancient Rome, was ready to follow at his patron's heels, and to execute any commission however base or ignoble, which that patron might command. And when we turn to the purely scientific aspect of the term "parasite," the associations connected with the name are again anything but agreeable. But life is not all "sweetness and light;" it has its unsavoury but apparently necessary side as well; and a very important necessity exists for our knowing something, not merely about the nature of parasites, and about the ranks of the animal and vegetable worlds from which they are derived, but also concerning their special effects upon the human organism and upon the bodies of lower animals as well.

The importance of this subject, in so far as the general public are concerned, will be best demonstrated by a reference to "parasites" as they affect our food-supply and our health itself. But I should first desire, in commencing my lecture to-night, to ask your attention to a correction of one or two ideas concerning "parasitism" at large. We are too apt, from that popular standpoint, which utterly neglects the conclusions of natural history

science, to regard a parasite as being a thoroughly unnatural animal. Now, the naturalist, in reference to the history of any animal form, considers, amongst other details, its "distribution," and in so doing has his attention directed to the different quarters or "areas" of the world which animals and plants are found to occupy. When, therefore, we study the bodies of animals and plants in this light, we discover that a very large and important area of habitation is opened up for animals and plants of a lower kind. We learn that it is not in the least unnatural, if we may judge by the frequency of the habit, for one animal or plant to live in or upon another living being—animal, or plant, as the case may be. In fact, the more we know about this subject, in a purely biological or zoological sense, the wider we discover the sphere of the parasite to be—so wide, indeed, that in one sense it may almost be said to be co-existent with life itself. The words of the witty Dean Swift apply most aptly to the wide distribution of parasitic life:—

> So, naturalists observe, a flea
> Has smaller fleas that on him prey,
> And these have smaller still to bite 'em,
> And so proceed *ad infinitum.*

These words undoubtedly contain a large amount of scientific truth. For, in many cases, we may find even the parasite itself to be assaulted by humbler life. But, in any case, the wide distribution of the parasite, and the thoroughly natural character of the parasitic home and habitation, is a zoological idea which may well be impressed upon you at the commencement of this lecture.

In taking a brief and general survey of parasitic life, we may begin with the lowest fields of plant existence, and pass upwards to the highest animal life—that of man himself, who is not merely not exempted from parasitism, but who presents special attractions for the ravages of certain kinds of these organisms. To commence with the very lowest rank of life, we find many of the so-called "germs" which are almost undiscoverable by the highest powers of our best microscopes, presenting themselves under a parasitic guise and habit. Many of you will remember that at the recent meeting of the Social Science Congress in Dublin, Dr Cameron

read a paper detailing the results of Pasteur's observations in connection with the organism which has been found to cause *splenic fever*, a peculiar disease, otherwise known as *charbon* and carbuncle, or, in popular English, "a plague of boils," which affects sheep, cattle, and other animals, and may be transmitted from them to man. The researches of M. Pasteur have proved that this disease is caused by an organism, probably a plant of the humblest grade; the full history of which takes almost the scientific work of a lifetime, and a patience excelling Job's, to discover. Then, passing from these "germs," which undoubtedly are the causes of our zymotic diseases and fevers, to parasitic plants, we find illustrations of parasitic habits in certain plants, several of which will be perfectly familiar to all. For instance, take a plant which will acquire historical and social importance a few weeks hence—the mistletoe. This plant is a parasite of the oak and the apple tree. Yet, it is not a perfect parasite, because, having green leaves of its own, it can, to a certain extent, make food for itself. The parasitic plant known as "dodder," which ruins our crops when growing in abundance through a process of literal strangulation, is a purer parasite than mistletoe, in that it is dependent for food on the plants to which it pays its nefarious attentions. But if you study the history of lower plant life more intimately, you will learn that nearly three-fourths, if not a larger proportion, of the skin-diseases of man are caused by lower vegetable growths. Thus, for example, you have the *tinea* or "ring-worm," caused by a low fungus called *Tricophyton* by botanists. Then, again, you have *favus* affecting the scalp, and that again is a skin-disease caused by a fungus of another kind called *achorion*. There is also another well-known skin-disease—which is in fact a genus of skin diseases, having a considerable number of species or varieties—called *herpes*, which not only affects man, but which may be transmitted from him to animals. This also is the direct result of the growth of a particular kind of fungus in the skin. We thus discover that the lower orders of plants possess, even in the domain of human life, a very wide area of distribution. And passing to a lower life-form still, we shall discover the silk-worm to be affected likewise by a parasitic

form of plant life. In other words, we shall have to recognise as a pest of the silk-insect, the small *Botyrtis*, a miscroscopic plant, which nearly ruined the commercial prosperity of France a few years ago, in so far as the silk-producing industry was concerned, by causing the *muscardine* disease.

I need not say more on this head to show you how life in its lower deeps possesses relations of importance and interest with life in higher ranks, or even its highest grades. We may now try to trace, in order to obtain an intelligent view of our subject, how parasitism begins. We shall find that this condition, like most other conditions of animal life, exhibits grades and stages advancing from small beginnings towards a more perfect and representative type. We may, perhaps, make clear the relations between parasites and the animals they affect through the use of an extremely common-place metaphor. How, for instance, should we define, in social life, the relations existing between the "lodger" and his "host" or landlord? Probably by saying that the former received shelter from his host, but was not dependent on him for anything else in the way of food. More plainly, the pure "lodger" has to do his own cooking and providing; and so the first class parasites we shall call "animal lodgers."

In a diagram before you, there is represented the animal known as the sea-anemone. The poet Southey long ago called them "animal-flowers;" and as you see them in the rock pools of the Firth of Forth, or indeed in any other locality, you can realise the beauty and applicability of the poet's simile. It is a creature entirely flower-like in its appearance; with a central mouth, surrounded by a perfect array of tentacles, adapted for capturing the prey in the shape of the unwary crabs that stumble against them. Now, it is a well-known fact that some of the large species of tropical sea-anemones act the part of "hosts" to certain small fishes. The fishes have been seen to swim in and out of the mouth of the anemones, and are known to dwell in their body-cavity. This relationship becomes the more surprising, when you reflect that a single touch of your finger, far less placing your finger within the mouth, causes the

anemone at once to contract itself in the fashion represented in the diagram and to become, from a flower-like form, a mere conical mass of jelly. Place that fact in relation to the previous one, and I think you can readily understand the beginnings of the parasitic life here. For, however the association began, the fish may be said to be a mere "lodger" within the body of the anemone. It feeds outside the host's body, or, in other words, "dines out;" but the curious fact of its lodging safely within the body of an otherwise voracious animal, remains to illustrate a new phase of placing one's head "in the lion's mouth."

Passing from the relation of the mere animal "lodger," we find a something added to the functions of the latter, when we discover that some animals literally "board" as well as "lodge" with another animal. The "boarder" in human life, is not merely taken in by the host, but he is taken in, and, in polite parlance, "done for." Here, however, we may realise some examples of what is said to be the practice of some sharp "boarders" in human life—that of "taking in" and "doing" their landlords. If we reflect, at least, upon the harm the parasitic boarder, living in the very kitchen, or digestive system of its "host," may do to the latter, we readily see the analogy between the dishonesty of the human, and the harm of

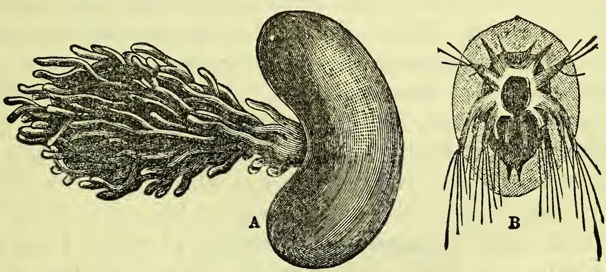


Fig. 1.

SACCULINA—A, Adult, showing the roots of attachment. B, Young *Sacculina* or *Nauplius*.

the animal parasite. Here, on the wall before you, is a very well-known parasite called the *Sacculina* (fig. 1. A), which attaches itself to the bodies of hermit crabs. The Sacculina may be said to be

merely a sausage-shaped sac or bag. Suppose, then, we have such a sac-like animal, without any definite internal organs, but from whose body a number of roots grow into the crab's liver, we may thus discover a parasite, not merely depending upon its host for lodgment, but one which also feloniously abstracts from that "host" the nourishment it provides for its own wants. The history of a *Sacculina* is, however, worth a moment's study. This curious organism begins life as a little free swimming animal (fig. 1. B), possessing three pairs of legs, and called a *Nauplius*. It has an eye in the middle of the body; but it possesses no internal organs, however, and it bears a resemblance to those animals called "water-fleas," which as many of the citizens of Edinburgh will remember attracted a considerable deal of zoological attention, on the promulgation of a certain defunct water scheme. Indeed, the Sacculina stands somewhat in the position of a "poor relation" to the "water-fleas" themselves. But a noteworthy fact in the history of the Sacculina is that this sac-like parasite, itself a lodger and boarder on the crab, starts life under the guise of a water-flea, and only drops its legs and other organs when it settles down ultimately into the parasitic condition. For, after a free swimming life, the little Sacculina loses its legs and its eye, and, attaching itself to the crab, develops its roots, and becomes the mere pulsating sac (A) I have described. It thus furnishes us with an example of an organism becoming degraded, or backsliding, as it were, from a higher to a lower condition. And its history teaches us, amongst other things, that the original condition of most if not all parasites is a free-living state. Their parasitic habits, like habits amongst ourselves, are things which grow by degrees, and in time become the normal way of life. But in the case of a third series of parasites, the history of which I am about to describe, we shall find animals which are not merely "lodgers" or even "boarders," but in addition may be called "tenants by right." If we study the tape-worm or the fluke—the former inhabiting the alimentary canal of man or of the other warm-blooded animals, and the latter living in the bile ducts of the sheep's liver—we may discover that these parasites are not

merely in a position to obtain lodgment and food at the expense of their hosts, but may be said to be in their whole history "tenants by right." They pass through the whole course of their development within the bodies of their hosts; and they select, through the operation of the laws of their life, a particular position, which they come to acquire as their lawful and natural area.

We thus find that parasites may be conveniently classified into (1) pure "lodgers," a condition representing the beginnings of parasitism; (2) "boarders," or that more advanced state wherein one animal becomes dependent on another for food as well as for lodgment; and (3) "tenants by right," under which class we find the most typical parasites, dwelling usually in one particular part of the animal which they affect, and in that part or organ alone. Parasitism, as I have already remarked, has its degrees and stages of perfection; and this observation, therefore, clearly shows that it is an acquired, and not original, condition.

The human area and its parasitic tenants may now engage our attention. It is in this department of inquiry that the main current of our thoughts to-night may be said to flow; and it is in this aspect of our subject that its relations to health are most clearly to be traced.

The human area, it may be remarked, presents a very considerable number of parasites for the notice of the naturalist. Some of these are harmless, others are annoying, and others, again, are of a highly dangerous character. As an illustration of the harmless type of parasite, we may select one which, as it happens, has no common name, but only a scientific appellation. It is called

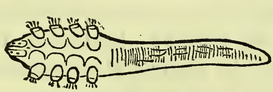


Fig. 2.
Demodex, a mite inhabiting the follicles of the human skin.

Demodex (fig. 2), and its specific name is *folliculorum*—a name indicating that it inhabits the little crypts or follicles of the human

skin. There is one position in man which it invariably occupies, and that is the follicles of the skin at the sides of the nose. Its average length is about the eightieth part of an inch. It is unquestionably a kind of mite, but it exhibits that degradation of structure which we have noted to be the results of parasitic existence. It resembles the ordinary mites in having four pairs of legs, and in other characteristics of the class; but we discover that the legs have degenerated to form mere stumps, so that the animal, in obedience to the law of use and disuse, and having no need of limbs, has become limbless accordingly. It is believed on the best authority that very few individuals are exempt from this parasite. Some statistics say forty out of sixty persons possess Demodex as a tenant; others maintain the proportion to be one in ten. We are ignorant of its existence, very probably, from the fact, that it is so thoroughly harmless. But in the dog it may give rise to annoyance, as it has been estimated that in a single follicle of the dog's skin no fewer than 200 of these parasites may be found. The dog, therefore, exhibits in an increased degree a condition which is harmless in man. The species which affects the dog is slightly different from that which exists in man. In Demodex, then, we see illustrated a case of pure parasitism, but one, at the same time, of a harmless kind. Very different, in the results of its life at least, is the parasite which produces the disease known as "itch." This parasite is likewise a mite, the female of which burrows beneath the skin, and forms regular channels or galleries in that tissue. This mite also exemplifies the operation of the law in parasitism that degeneracy follows disuse, for the two hinder pairs of legs are only partly developed. It is a well-known fact that in the case of this mite unhealthy conditions of body, or want of attention to personal cleanliness, are predisposing conditions for its attacks; preparing the skin, as a soil is prepared for the seed, to become the habitat of this animal.

The parasites which next await us, bring us directly within the domain of the physician and sanitarian. All parasites are not of equal importance in relation to human health. In one case a parasite, such as the *Trichina*, may affect man so powerfully that its invasion may be attended with a fatal issue. There are other

parasites, such as the tape-worms, which do not produce death, but which may produce very serious constitutional disturbance, and lay, at any rate, the beginnings of ill health. Then there are parasites which affect man in relation to climate, and which produce disease only under special conditions—such as that of tropical climate, for example. Such is the Guinea Worm, now and then seen in British hospitals, burrowing beneath the skin of the legs, and giving rise to painful swellings. But these latter considerations lie outside the main drift of my remarks to-night. For unquestionably it is those parasites that have the power of affecting us through our food, and through their being included in our dietary, which possess for us the highest importance.

In such a parasite as a "tape-worm," we may find a convenient starting point, because these parasites are unquestionably the most common visitants of the human territory. Let us firstly inquire, What is a tape-worm? In the answer to this question you will find a natural history study of, I hope, some little interest. The tape-worm has received its common name from its very obvious band or ribbon-like shape. In looking at it closely, we discover that all its parts are not of equal value or importance. Thus a tape-worm which may measure 20 feet in length, perhaps, possesses firstly a *head* (fig. 3, 1), which may not be larger than the head of a small pin. Immediately succeeding the head is a number of small joints forming the so-called *neck* (Fig. 3, 1 *d*) of the animal. Then succeeds the great bulk of the animal, composed of a series of *joints*. There are thus three elements in a full-grown tape-worm—*head*, *neck*, and *joints*. But when we think of a tape-worm, we almost insensibly glide into the idea that it must correspond to an ordinary worm, such as an earth-worm or a sea-worm. The naturalist, however, will speedily show cause for a change of ideas on this point. He will tell us that in considering the tape-worm we are regarding not one animal, but a veritable colony of animals—not a *single* individual, but a *compound* individual. Study for a moment how the tape-worm grows. The animal is ever increasing in length, and new joints are continually being produced from the neck extremity. The oldest joints are those which are furthest away from the head.

So long as the tape-worm head remains attached to the lining membrane of the alimentary canal of the animal it inhabits, so long it goes on producing joint after joint, and so long it adds largely to its increase and individual extent.

But let us now examine the constitution of a tape-worm "joint" (fig. 3, 2). The thin joint of a tape-worm is remarkable in one respect, namely, in that its whole interior seems to be occupied by an *ovary*, or egg-producing apparatus. We also note that each joint possesses an individuality of its own. The branched or tree-like structure you see in the centre of the joint (fig. 3, 2) is the ovary; and when you learn that each joint contains many thousands of eggs—or when you consider, in the light of that fact, that a tape-worm possesses hundreds of such joints—you can form some adequate conception of the enormous number of eggs which a single tape-worm is capable of producing. The tape-worm head is provided with a circlet of small hooks (*a*), which enable it to attach itself to the lining member of the intestine, whilst four suckers (*c*) also aid this attachment. Thus, we see in each joint of the tapeworm a semi-independent animal, and a distinct member of the elongated colony. Each joint is capable of producing perfect or fertilised eggs, and each egg can give origin to a new tapeworm, when the egg is placed under the requisite conditions for ensuring its development.

Fig. 3.

ANATOMY OF A TAPEWORM.—1. The head and neck (largely magnified)—*a*, hooks; *b*, head; *c*, suckers; *d*, neck. 2. A single joint (*proglottis*), (magnified), showing the branched ovary and the generative pore or opening at the right-hand margin of the joint.

The development of the tape-worm becomes a subject of the highest importance, from a sanitary point of view. The eggs contained in the joints, escape from the body of man, and are distributed usually in sewage over the surface of the earth. It must be borne in mind that the egg of the tape-worm is a structure

which, even before it leaves its "joint," or parent-structure, already contains within itself the young animal. The egg appears at this time as a small sac or bag, with a tolerably hard outside envelope, within which is the minute embryo, or young animal. The very earliest or primary steps of development have been undergone even while the egg was within the joint, and when the latter was within the body of its "host." Now, this egg requires to pass through a complex cycle of development; and we may at least gain one comfort in our study of the life-history of this parasite, namely, that the chances of destruction which await the young worm in the course of its development are so great, that in reality the tape-worm race is thus prevented from becoming a literally teeming population on the face of the earth.

We naturally divide the life of a tape-worm into two "epochs." The first epoch is passed within a different animal from that which harbours it in the mature state. The first host in the case of the common tape-worm (*tænia solium*) is the pig, and the second is the man. Suppose that the egg of a tape-worm is swallowed by a pig, the stages of its development are easy to trace. Development would then proceed, and would end by placing the worm before us at the end of its youth. If a man swallowed the egg of the common tape-worm, it would, as in the pig, simply end by becoming an imperfect worm. For the egg, to develop into a human tape-worm, requires to pass the first part of its history within a different "host" from that in which it attains its maturity; and the first "host" in this case, I repeat, is generally the pig. If, therefore, a pig swallows the tape-worm egg obtained from the digestive system of man, the gastric juice of the pig's stomach soon dissolves away the covering of the egg, and the small embryo is liberated. Under what guise does this young worm appear? As a "boring larva," or, as naturalists call it, the *proscolex*. Its name of "boring larva" indicates that it possesses a boring apparatus of hooks, and by aid of these hooks—not being permitted by the laws of its development to stay in the digestive system of the pig—it bores its way from the pig's stomach to take up its abode in the *flesh* or *muscles* of the animal. But

even here, it cannot become a perfect animal or tape-worm. Within the pig's body, in short, it cannot advance beyond its youthful stage. Located in the muscles of the pig, it develops around its body a kind of bag or "cyst;" and, appearing in this guise, was known of old as a "cystic worm" or *scolex*, before its true nature was suspected. These young worms may be discovered as mere white specks in the flesh of the affected animal.

Here, then, the days of the tape-worm's youth may be said to end. If, as is extremely unlikely, the pig dies a natural death, and is respectably interred, there is an end at once to the pig's troubles and its aspiring tape-worm guests. But if, as is more likely, the pig passes into the hands of the butcher, the beginning of the tape-worm's adult stages looms in the distance. If a veterinary surgeon were to see the flesh of the infected pig at this stage, he would at once pronounce it to be unfit for human food, and he would in addition inform us that the pig had been attacked by "measles." "Measles," in this sense, is simply a name given to the symptoms produced in the pig and other animals by the boring inroads of the youthful tape-worms.

Now, if a piece of that pig's flesh should be eaten by a man the second part of the life-history of the tape-worm is immediately inaugurated. For, when the little cystic worm from the pig's flesh lodges in the human stomach or intestine, the bag or cyst falls away, and the little head and neck are alone left. But the head and neck contain, *in posse*, all the vitality necessary to produce the mature tape-worm. The head attaches itself to the lining membrane of the man's digestive system by its hooks and suckers. Thus located, the neck begins to produce its joints in the form of buds. The buds nearest the head, at first immature, soon acquire all the characters of well-developed "joints," as they are pushed further and further from the head. These joints develop the egg-producing apparatus, and other organs proper to adult tape-worm life. And thus, in due time, you find the budding tape-worm arriving at the stage from which we started—namely, at the adult or parent form, ready to send abroad its eggs, each of which is again capable of illustrating this marvellous cycle of development.

Thus, the life history of a tape-worm may be succinctly summed up by thus tabulating its stages :—

1st Epoch.	(1) The *Egg*, liberated from the human digestive system. (2) The *Boring Larva* or *Proscolex* passing from the pig's stomach to its muscles to become— (3) The *Scolex*, or *Cystic*, or *Bladder worm.*	The Pig is the "Host."
2d Epoch.	(4) The *Immature Tape-worm*, consisting of the head and neck of the *Scolex* eaten by man in the muscles of the pig, giving origin to— (5) The *Perfect Tape-worm* in man's intestine, produced from stage 4 by budding. (6) The *Joints*, which are continually passing from man's intestine, and which contain, each thousands of eggs, leading us back to stage 1.	The Man is the "Host."

Other tape-worms having an essentially similar history may be found within the human domain. The form we have just con sidered is the *tænia solium*, the first "host" of which, as we have seen, is the pig. But it so happens that we obtain from under-done beef the *tænia mediocanellata*, or the "beef tape-worm," as it is called. Naturalists call its immature stage the "beef-measle." This worm may attain a length of 30 feet, but, unlike the *tænia solium*, its head is utterly unarmed. If we study the life-history of this second tape-worm, which is obtained from under-done beef, it will be found to exhibit the same stages as the *tænia solium ;* the only difference being that we should have to insert the ox as the first, and man as the second "host." But far more important is it to understand that this principle is carried out practically in all tape-worms—that is to say, that we never find any given tape-worm perfect in the same animal from which we obtain its early or "scolex" stage. Thus, the little cystic worm which exists in the liver of the rabbit, becomes, when eaten by the dog, a tape-worm of that animal. The little cystic worm or "scolex" of the rat and the mouse, becomes the tape-worm of the cat; and another curious cystic worm that inhabits the brain of the sheep becomes a special tape-worm (*tænia cœnurus*) of the dog.

But that a much more serious form of parasitic attack, in so far as the tape-worm race is concerned, awaits man, is disclosed by the history of another tape-worm *(Tœnia echinococcus)* (fig. 4), which inhabits the intestinal canal of the dog. This is one of the smallest of the tape-worms, and seldom exceeds $\frac{1}{4}$ of an inch in length. It develops only some four joints, including the head (*a*), which has a double crown of very large hooks for attachment to the dog's digestive tract. Four suckers also exist for the same purpose. This small parasite, however, acquires a high importance in the human area, from the fact that man may become the *first* "host" in its development; just as the pig is the first "host" to his own tape-worm. Thus, if man swallows the egg of this tape-worm—obtained, say, from the surface of unwashed vegetables that have probably borne some relation to sewage manure—the egg passes, not to the muscle or flesh of man, whither we traced the egg of the *tœnia solium* in the pig, but, as a rule, to man's liver. It rests in the liver, just as the "measle" of the pig rests in the flesh of that animal; and in the human liver this youthful tape-worm of the dog gives rise to an aggravated form of liver disease known under the name of *hydatids.* The liver in a bad case of hydatids exhibits a series of fluctuating tumours; and after death—for only too frequently the disease has a fatal ending—we may find the liver to be perfectly invaded by these cysts. The destructive nature of these young tape-worms in the liver is chiefly due to a peculiar characteristic of their development. The young forms of the common tape-worm in the muscles of the pig or ox are each of single nature. But each young *scolex* of this dog's tape-worm, when settled in man's liver, has the power of producing other cysts, or "heads and necks," in its interior by a process of budding. The parent, or first cyst or bag, may thus attain a very large size, and then appears as a large tumour in the liver, filled

Fig 4.
Taenia echinococcus from the Dog. *a*, head; *b*, the last and mature joint; *c*, the generative pore (magnified after Cobbold).

with fluid, and containing within it "daughter cysts," as they are called, each of which, in turn, may contain many "heads and necks." Each of the latter, if swallowed by a dog, would of course give rise in that animal to the mature tape-worm.

A curious fact concerning tape-worms is found in connection with the history of the broad-headed tape-worm, or the *bothriocephalus latus*. This worm is never found native in England or Scotland; but it has been called the "Irish tape-worm," because it is indigenous in that country, where it may thus constitute a real "Irish grievance." It is certainly common in Western Switzerland and adjacent parts of France, and it also occurs in Geneva, and in Northern Russia and Sweden. This tape-worm is supposed by some authorities to pass its first stages of development within the bodies of certain fresh-water fishes of the salmon and trout kind; or, according to others, within the fresh-water fish known as the bleak. Some naturalists, on the other hand, maintain that this tape-worm may need no first "host" at all. We know that from its eggs, when placed in water, a little free boring embryo issues. But, as my friend Dr Cobbold remarks, the very presence of these hooks suggests that this young worm must naturally bore its way into the tissues of an animal, just as the youthful scolex burrows into the flesh of the pig. Be that as it may, the important fact to be borne in mind is this—that a fish-eating population is liable to incur infestation from these tape-worms, just as the flesh-eating population is liable to infestation from those to which I have already referred. A point of interest in the history of this "broad-headed" tape-worm is its size. It may have as many as 4000 joints, and may grow to be 25 feet long, and over an inch in breadth.

Before quitting the group of the "flat worms," let me remark in reference to the "hydatids" of the liver of which I have spoken, that this is a disease extremely prevalent in Iceland, owing to the immense number of dogs kept by the peasantry, and owing to the familiarity with which the canine population is there treated. An Icelandic peasant may often possess half a dozen dogs, which share his habitation, and it is obvious that the unnecessarily close relationship of the dog and his owner in such

a case, gives opportunity for the passage of the germs of this parasite from the dog to the man. The high importance of sanitary precautions in the matter of dogs may be seen, when we learn that "almost the sixth part of all the inhabitants annually dying in Iceland" fall victims to the hydatid disease.

Last of all may be mentioned, in connection with the tape-worm group, the curious history of the *tænia cucumerina,* another species infesting the dog's intestine in its mature state. The eggs of this worm, passing from the intestine of the dog, are swallowed by the dog-louse infesting the animal's skin. In the louse, as a first "host," the worm attains its *scolex* stage, just as the young tape-worm of man attains that stage in the pig. The dog next swallows the louse in cleaning his skin; and thus introduced within the digestive system of the dog, the young tape-worm from the body of the louse, develops into its mature form within its canine host, whose body it has literally never left throughout its development. The "vicious cycle" of parasitism is plainly detailed in such a case as this, whilst Dean Swift's lines find here a highly practical illustration.

Passing now to the Liver Fluke (*Fasciola hepatica*), which, although not of much sanitary interest, may yet affect man, we discover in the fluke a parasite which kills thousands of sheep every year, by inducing the disease known as "rot." The fluke you may see for yourselves by procuring the liver of the sheep, and examining the bile ducts. It is a flat, oval body (fig. 5), about half an inch in length, pro-

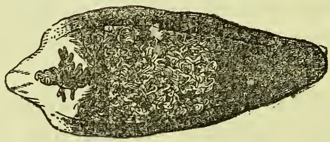


Fig. 5.

The Liver Fluke (*Fasciola hepatica.*)

[The "head" extremity exists at the left-hand side of the figure.]

vided with suckers for adhesion, and resembling in many respects the single joint of a tape-worm. Each fluke is capable of producing large numbers of fertilized or perfect eggs; but it is a

single animal, and not like the tape-worm, a "colony" of forms. Occasionally the fluke may be found within the human domain. Surgeons and physicians have now and then put on record curious cases, in which this fluke has occasionally been found burrowing beneath the human skin and scalp. But these are rather rare occurrences. The only explanation which may be given of such cases is that which shows that in all probability man obtains the fluke exactly as the sheep obtains it, namely, from drinking impure water, and especially from water likely to contain pond snails, which may be said to play the part of intermediate "hosts" in fluke development. For the larva of the fluke swims at first freely in water, and it is possible that this larva may be taken into the body of man, as into the body of the sheep, in the act of drinking. A very serious disease, however, may be caused by an animal also occupying a place in the fluke-group. This is the Egyptian blood-fluke, or *Bilharzia*, so called after a physician practising in Egypt, and who discovered this parasite in 1851. It is a curious parasite, measuring about half an inch or little more in length. The female is larger than the male fluke. The bloodvessels of the kidneys appear to be the favourite haunt of this parasite, and the eggs appear to escape from the ulcerated surfaces arising from the irritation produced by the parasite.

Passing now from the "flat" worms to the group of the "round" worms, several of which find in the body of man a habitat, we may briefly note two species which are tolerably well known. For example, a very common human parasite, is the "common round worm" or *Ascaris*, which inhabits the human intestine, and may attain a length of from 4 to 6 inches. It causes ill-health probably from the constitutional irritation induced by its presence. Another parasitic worm is the "small thread worm" or *Oxyuris*, from which children are apt to suffer so persistently. These latter worms do not bear any special relation to food. The manner in which they are acquired, in other words, is not so important as a question of health as it is one of personal cleanliness. Infection is probably direct—that is, the eggs probably pass from the digestive system of an already infected subject to be swallowed by another person.

There are, however, other "round" worms which bring us within the spheres of the physician, since they may cause serious disease in man. Of these the Guinea-worm (*Dracunculus*) is an example. This form is supposed by very good authorities to have been the fiery serpents of the ancient Israelites. Plutarch, at any rate, has a reference to "worms" infesting people on the Red Sea, and taking up their abode in the legs and arms of the victims. In all probability the young of this worm enters the body in water. It is especially common in India, and its habitat is usually the lower limbs. The head of the worm is found at the top of a swelling, from which it is extracted by being slowly coiled round some object. The essence of this operation is to avoid breaking the worm, inasmuch as, through that accident the eggs, of which the worm is full, may escape into the tissues and cause fresh irritation. The Negroes of the Gold Coast are said to be specially dexterous in the removal of this parasite, the young of which, long believed to exist in the form of the tank-worms, common in India, are now proved to pass their early stages within water-fleas. By drinking water containing these "fleas," the young Guinea-worm is located within the human body, and burrows its way towards the skin-surface of man.

With the name of the *Trichina* every one must by this time be perfectly familiar. Not so long ago our newspapers chronicled the fact that questions were continually being asked in Parliament concerning the nature of American pork and butter, which were supposed to have been affected with this parasite. It is an evident fact that many of our legislators would have been none the worse for a little training in natural history, to have enabled them to satisfactorily determine the nature of this bugbear, the *trichina*, and of the disease which it produces, namely, *trichinosis*. The fact remains, at any rate, that a training in natural science is a valuable aid to a larger section of society than the world of zoologists and botanists. As a matter of deep social interest, the life-history of this animal is therefore of great importance, and, if I sketch it somewhat fully, it is because, of all parasites, it has perhaps the greatest interest for civilised man.

The *trichina* was discovered by Sir James Paget when dissect-

ing as a student in St Bartholomew's Hospital in 1834, and in 1835 Professor Owen described and named it *trichina spiralis.* The latter name refers to the spiral fashion in which each *trichina*

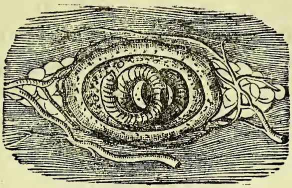


Fig. 6.
Immature or young *Trichina* coiled in its cyst in muscle (magnified).

(fig. 6) lies coiled up within a small bag or cyst. As seen in the human muscle or flesh, these *trichinæ* appear as mere white specks. The average length of the male worm (fig. 7) is about the eighteenth

Fig. 7.
Mature Male *Trichina* (magnified).

part of an inch long; but the female (Fig. 8) is larger, being about the eighth of an inch long, whilst the capsule or cyst in which it is

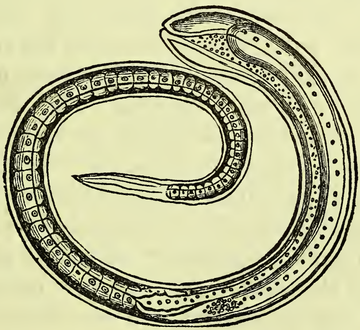


Fig. 8.
Imperfect Female *Trichina* removed from muscle, showing eggs in interior (magnified)

contained is about 178th part of an inch long, and the 130th part of an inch broad. The importance of a knowledge of the *trichina's*

development consists in such information supplying us with the best safeguard against infection. The proverb that "knowledge is power" receives no more apt illustration indeed, than when applied to the case of parasites, and to the zoological history which shows how infestation may be avoided. The male *trichina* may be distinguished from the female worm by a forked appendage in which the tail terminates, but the body of the latter is stouter than that of the male. A very large portion of the interior of the body in the female worm (fig. 8) is occupied by the egg-producing apparatus, and here, as in the tape-worm, we have to note the extraordinary fertility of the parasite. I am certainly speaking within, rather than over, the limits when I say that each mother *trichina* is capable of producing, at the very least, from ten to fifteen thousand young. These young are further produced *viviparously;* that is to say, the eggs are hatched within the parent body, and the young pass from the parent ready to enter upon their further development.

A preliminary observation may be said to contain the key to the whole history of the trichina. It is this: that, as we find the trichina existing in the muscles of the pig (fig. 6), they are immature. In this stage, each trichina is incapable of producing young. Suppose, however, that a portion of the infected flesh is eaten by man, then, as in the case of the tape-worm, the trichina falls on its feet, as it were, and it rapidly advances towards the perfection of its kind. They are capable of living from four to five weeks within the human digestive system. But within the second day after they have been swallowed by man they may become perfectly matured; their reproductive energies are perfected, and then ensues a marvellously rapid increase of the race. Each mother-trichina within the human digestive system, is capable of producing her thousands of young; and if we consider that these parent trichinæ themselves may number perhaps hundreds or thousands, we may understand, in a new sense, the old sayings concerning the strength of united effort and the power of little things when multiplied to form their cohorts and legions.

What, then, is the next process that ensues? The horde of minute young now begins to migrate from the stomach to seek a

resting place in the muscles or flesh of the individual. They resemble somewhat the youthful tape-worms in this respect. For this purpose the whole brood burrows its way from the stomach to the different muscles; and it is during this process of migration, and whilst the parasites are wandering from the stomach to the flesh, that the serious nature of the trichina-disease becomes apparent. For the patient then becomes afflicted with pains compared with which, the proverbial tortures that afflict the just are as nothing. The excruciating pains which attend the migration were amongst the first symptoms noticed in this disease. In a severe case of trichinosis, the disease goes on from bad to worse, and ultimately the patient's whole body becomes literally disintegrated, delirium ensues, and the patient dies in a state of extreme exhaustion.

But, in a case of milder type, the pain ceases whenever the young trichinæ has arrived at their home in the muscles. If the patient's strength can but hold out until the young trichinæ settle down in his flesh, he then may be said to be safe. There, each young trichina surrounds itself with a small cyst, such as we saw the parent (fig. 6) to possess; and no further development of these young can take place, unless, indeed, cannibal tendencies should be developed, when transmission of the young brood to the stomach of another individual would perfect them for reproduction, and would result in the development of a fresh generation of young. The last scene in the life-history of the trichina in man is extremely interesting. After the trichinæ have become encysted in the muscles for some months, each trichina exhibits a process of degeneration. It then becomes a mere speck of lime deposited in the muscular tissue. It is in this degenerated state that the trichina is most frequently met with in the human subject in the dissecting-room. How, it may be asked, does the pig get the trichinæ which inhabit its muscles, and which must have migrated from its digestive system, as their young will migrate in man? For the pig must have swallowed the parent trichinæ, and must also have suffered from the trichinæ disease. It is believed that the rat is the source from which the pig gets its trichinæ; and in all probability, the circle of development may be said to be completed

by the rat in turn obtaining it somehow or other from man or from any other "host" of these parasites. As regards the number of trichinæ which may be contained within an animal, it is calculated that within a single ounce of flesh in an infected cat upwards of 325,000 parasites were contained. It has been calculated, also, that in an infected man, upwards of 40 millions of trichinæ may be present. Dr Cobbold tells us that in an ounce of pig's flesh 80,000 trichinæ were present; and he adds that the consumption of a pound of that flesh would give to man something like 400 millions of these "lodgers and boarders."

Our own country, happily, is almost entirely free from trichina disease. But on the continent, and especially in Germany, where the habit of eating uncooked pork or smoked pork is general, this disease is tolerably frequent. At first, indeed, the cause of this disease was so obscure that the cases gave rise even to ideas of poisoning; and it was only after the discovery of the trichina, and after the scientific investigation of its natural history, that the true nature of this disease was made known.

The time, however, has now come for a summary of the conclusions to which our studies naturally lead. I trust you have not been altogether horrified with these scientific details without at least some salutary effect following upon this process of laying bare the information and knowledge which usually remains in the possession of the naturalist and physician alone. I think I can sum up the health aspects of the subject in six axioms or pieces of useful information, the practical value of which I must leave to your own common sense to enforce.

Thus, firstly, we must insist upon all meat being thoroughly cooked, and the word "meat" ought to include fish. The reasons for these precautions follow upon your previous studies of to-night. First of all, from uncooked pork we obtain the pork tape-worm *(tænia solium)*, and from underdone meat, the beef tape-worm; whilst from uncooked fish, man may get the broad-headed tape-worm (or *bothriocephalus latus*), and from uncooked pork we may receive a deadly cargo of *trichinæ*. It is interesting to know that we can appeal to actual experiments by way of proving

the accuracy of the advice which tells us that by means of thoroughly cooking our meat at a *high temperature* we may enjoy an absolute immunity from these parasites. A temperature of 140° F. has been estimated by the highest authorities to be that which no parasitic life can survive. If any one ate a piece of trichinised flesh—although it might, perhaps, be a rash experiment—which had been kept at this temperature for some length of time, he would in all probability escape the trichina infestation. Lesson the first is, therefore, one which advises us to cook our meat thoroughly, and to eschew a taste for underdone meat of all kinds.

Secondly, an equally important precaution is that of washing thoroughly all raw vegetable products. The reason for this piece of advice becomes clear when we reflect that we thus protect ourselves from the eggs of tape-worms, including the eggs of the dog's tape-worm which produces "hydatids" in the human liver. Even fruits, and especially such as have been picked up from the ground, without preparation may contain the germs of parasitic life. Raw vegetables of all sorts, such as lettuces and the like, used for making salads, for example, should be carefully washed to avoid danger.

In the third place, we should never drink water from any suspected or likely source of infection. By such sources I mean the water of canals and ponds, or of any brook which contains large quantities of vegetable matter, or which may harbour water fleas and water snails. From these latter animals we may obtain the young of certain tape-worms, and likewise the embryos of the liver fluke.

Fourthly, care must be taken of the general health. It is very important to remember in this connection, that parasites require a special soil for their growth, just as plants and animals at large require their special surroundings. And, therefore, other things being equal, these parasites are less likely to thrive in an individual whose general health is good, than in a subject of feeble constitution.

Fifthly, we ought to have—in so far as "hydatids" are concerned — special care of our dogs. Humanity to the dog is

perfectly compatible with keeping the dog at a respectful distance. The Icelandic practice of living on equal terms with our canine friends, results in the continual presence of "hydatids." The dog is happy and man safer when the former is relegated to his proper sphere—that of man's friend, but not his bedfellow or co-tenant of his room and sharer of his cup and platter.

Sixth and lastly, the old view of the "sanctity of dirt" has certainly no application to the modern question of parasites. Strict attention to every detail of personal cleanliness, is at once the beginning and the end of the advice which shows us the way of escape from the subtle foes that everywhere environ our lives.

In bringing this discourse to a close, it may be well that I should refer to one or two points connected less with the sanitary aspects than with the scientific side of my subject. If I offer, by way of conclusion, a few remarks upon the purely scientific questions involved in the discussion of parasites and their history, you may be the better enabled to reflect upon the causes which have wrought out the singular relationship we have seen to exist between parasites and their hosts. I presume no reasonable person would dream of maintaining for a single moment that these hosts were created complete and perfect, with the parasites dwelling in their interior. Such an idea, if entertained at all, can only present itself as the legitimate outcome of an absurd theology, or of an equally childish and unreal conception of the constitution of living nature. Such an idea, moreover, is contrary to evidence of the most positive character, which assures us that parasitism, both as regards host and guest, is an acquired and not an original condition. It is the result of laws and conditions of life's development which are everywhere and at all times in operation around us—modifying universally the worlds of life, from the humble lichen to the stately pine—from the monad-speck, that hovers on the twilight of animal existence, to the occupant of the human estate himself. We can thus trace all degrees and gradations of the parasitic life, and we may follow it from cases in which there is mere association, to those in which lodgment alone is obtained within or upon the body of the host. We are led from these illustrations to examples in which the

association has become of a closer kind; in which the parasite, originally free, has become wholly dependent on its host; and in which organs and parts useful for nourishment, for movement, and for other functions have grown "small by degrees and beautifully less," until the parasite appears as the degraded product of an acquired and secondary existence.

There are abundant examples and proofs to be found in the animal world of the originally free condition of the parasite. Think of *Sacculina* (fig. 1), the "guest" of the crab, which begins life as a free-swimming, six-legged water-flea, but which ends its life as the sausage-like bag whose roots, interwoven into the liver of its host, serve to feed its worse than vegetative existence. So also the life-history of a tape-worm and of a fluke equally present us with a notable clue to the original history of the parasite race, in the free condition of the young, and in the curious migrations through which these forms pass. If, therefore, the subject of parasites can teach you any lessons of wider application than mere sanitary cautions, valuable enough in themselves, I should say that you may be led from a study of the mere "why" of the subject towards some clear conceptions of a rational philosophy of the living beings—a philosophy which teaches that the ways of nature are everywhere hedged about with the conditions that produce continual change and variation in the children of life. As parasitism has been a growth and not a special creation, we may likewise discover that the cure and repression of this condition is really a matter of bettering our surroundings. As certain environments produce the soils and constitutions wherein parasites flourish and grow, so other environments check their growth and extirpate their race. The philosophy which teaches you the manner of their growth and development, likewise includes the knowledge on which to found their cure.

Last of all, in a day and in an hour when morbid sentimentalism fetters the hands of an unselfish science seeking but the advancement of truth, and the safety, welfare, and happiness of man, as well as the health of lower animals, you may be prepared to recognise that our immunity from the parasitic diseases that literally walk in darkness to slay us, is largely due to the just, legitimate,

and reasonable sacrifice, in scientific investigation, of a few of our animal neighbours. You have heard of the fatality of certain parasitic diseases, and you will admit the desirability of saving the life of man and the lives of animals from such a fate. Yet I warn you that in making that admission you are taking the first step on a course which, if certain philosophers of both sexes are to be believed, will lead you to the antipodes of all morality and of religion itself. For the only means whereby we can discover at once the history of parasitic development, and the means of cure, consist in the sacrifice of animals to the artificially-induced parasitic disease. Over and over again, the most valuable results in the discovery of the where, whence, and how of dangerous parasites, have been obtained by the administration, to dogs and other animals, of the parasitic embryos. Our knowledge of the way of escape from the deadly "hydatids" of liver and elsewhere, and the knowledge which warns us against the fatal trichinosis, has been obtained in either case by the sacrifice of lower animals. Let me ask you who hold the power to make and to repeal laws in your hands, if the sacrifice of the lower to the higher life was not, and is not, more than justified in such a service? And when the hysterical wailing of a certain section of the public is heard in our courts and temples, lamenting the often theoretical pain to which lower existence has been subjected, you may perchance, with some echoes of this lecture ringing in your ears, reply, and reply boldly, that science has been more than justified in her unflinching pursuit of that saving knowledge, which, followed up through the pain and suffering of the lower form, rescues man from the confines of the dark valley and saves him from the "nameless terror" of his race.

THE BRAIN, AND ITS FUNCTIONS.

BY DR J. BATTY TUKE.

I HAVE but scant time for introductory remarks. When I arranged to deliver one of this course of lectures, I was duly warned by the excellent lady to whom we are mainly indebted for their institution, that my audience would be such as would not be content with the mere enunciation of dogma, that every statement would need to be substantiated, that to each commandment reasons must be annexed. And when I sat down to think seriously over what I was to say to you, I very soon discovered that were I to talk merely of what was good and what was bad for the brain, I should be only cataloguing facts and opinions, which you, in the abstract, were as well acquainted with as myself. This would have been easy to do, and we might have wiled away an hour in general talk. But I conceive it to be the object of this course of lectures to place before the public the fundamental facts and theories which influence the physician in his endeavours to prevent and to combat disease. These facts and theories are all based on the sciences of anatomy and physiology —the institutes of medicine. Starting on the assumption that you are entirely unacquainted with the anatomy of the brain, and that your knowledge of its functions is confined to a general abstract belief that it is the organ of the mind, I felt it would be only talking round the subject if I did not, in the first instance, present to you some of the leading facts connected with its structure and functions. This, then, is not to be, strictly speaking, a Health Lecture; it is to afford a basis for a discourse on Brain Health, which I hope to deliver to you on a future occasion, should what I lay before you to-night be found to possess such intrinsic interest as to induce you to return. I must beg your

indulgence in dealing with a very large, intricate, and difficult subject; I can only hope to produce to you a very few of the most important facts. Had I to deliver six, instead of one lecture on the subject of the brain, my task would be comparatively easy—but if I can convey to you, within the next sixty or eighty minutes, some knowledge which you do not at present possess about this magnificent organ, my object will be gained.

Distributed throughout the whole system, pervading every tissue, except bone and gristle, there is a system of thread-like organs called nerves. In the skin and muscles, the nerves are in the form of small fibrils of a white colour. As we trace them upwards, we find these fibres coming together, forming bundles which grow larger and larger, as bundle joins bundle, until they form great nerve trunks, which pass into the spinal cord. The function of these nerves is to convey impressions *to* the spinal cord and the brain, and to convey *from* the brain and spinal cord the stimulus generated in those organs productive of motion. As I must circumscribe my subject it will be necessary to confine ourselves almost exclusively to this class of nerves, leaving almost unheeded the nerves of special sense, *i.e.*, those of the nose, eye, ear and tongue, and also to leave unmentioned those related to the great internal organs. Although we will thus be shut off from many questions of deep interest we will have little enough time to devote to the consideration of the connection of the spinal nerves with the brain and to the arrangement of the tissue of that organ and of the spinal cord.

The brain and spinal cord is composed of nerve fibre, nerve cells, connective tissue, and blood vessels. Their substance is a soft semi-fluid mass, the brain, for instance, contains 75 per cent. of water, only 25 per cent. being animal matter. In the spinal cord there is less water. The spinal cord is contained in the canal of the backbone; the brain in the great cavity of the skull called the *cranium*, or brain case. The spinal cord gives off for the supply of the trunk and extremities thirty-one pairs of nerves, which pass out by as many holes in the backbone, and those from the brain, with the exception of those going to the eyes and nose,

emerge from the skull at its base by similar perforations. Notwithstanding these holes and the great hole for the passage of the spinal cord, the brain case is hermetically sealed by muscles and other textures, so that no ordinary impulse from without can have any influence on its contents. Let me illustrate this. When I fill a glass jar with water, and inverting it under water, raise it above the surface, the water does not descend, the glass jar remains full; water may be forced out by the introduction of any body, but when that body is removed water returns. This represents the condition of the contents of the skull, which, whatever may be their difference in quality, must always remain the same in quantity. The bearings of this remark will be seen further on.

Each nerve is, as I have already said, composed of bundles of fibres, and each fibre is composed as follows,—first, internally, a delicate thread, called the *axis cylinder*, which is believed to be the medium through which impressions are conveyed to and from the nervous centres. This is surrounded by a white substance named, after its discoverer, the *white substance of Schwann;* and externally, a fine membrane of connective tissue, which is simply for the protection of the inner tissues.* Now, mark how closely the structure of a nerve resembles that of a submarine telegraph cable. A telegraph cable, as you see, is composed of a core, the copper wire which, as you know, conducts the magnetic current,—this corresponds to the axis cylinder; second, a layer of gutta-percha, for the purpose of insulating the wire, that is to say, for preventing the access of any body which might divert the current,—this corresponds to the white substance of Schwann; and third, a parcelling of yarn for the purpose of protecting the gutta-percha,—this corresponds to the fibrous protective membrane. There is, however, a difference between the nerve fibres outside and those inside the back-bone and skull; the latter are not invested with the fine external fibrous membrane. They are protected by a connective tissue peculiar to the spinal cord and brain. This

* Connective tissue is applied to the structures which simply bind together the component parts of the various organs, and serve as a support for delicate tissues.

connective tissue, termed *Neuroglia,* or nerve-glue, is difficult to explain to a non-professional audience. It is an extremely delicate reticulated net-work of fibres pervading the whole organ. When I say you can figure it best to yourselves by supposing that this mass of tow represents a portion of brain connective tissue, (nerve-glue is a bad term, as it conveys the idea of an adhesive substance), and that these wires represent the nerve fibres, and these tubes the blood-vessels supported by it, you must remember that it is a tissue so fine and delicate that it can only be seen by the use of a very powerful microscope. I may best illustrate the coarseness of my illustration by saying that, were this tow and these wires a piece of an actual brain, the brain itself would be at least the size of the Castle rock. The nerve fibres of the brain and spinal cord are very delicate, varying in diameter from $\frac{1}{4000}$th to $\frac{1}{12000}$th of an inch, and, of course,are utterly inappreciable by the unassisted vision. There remains the nerve cells to be described—these are the most important organs of the nervous system; but I think it will be better to delay their consideration until I have described more fully the general anatomy of the brain and spinal cord.

The spinal cord is from fifteen to eighteen inches long; it is divided into two equal lateral halves by two fissures which nearly meet; it communicates with the brain through the great hole at the base of the skull. Throughout its whole length nerve fibres extend, but their arrangement is different in the front and the back portions of the organ. In the back portion of each half, or posterior columns as they are termed, as each nerve enters the cord a considerable number of its strands cross over to the opposite side and run upwards to the brain. The function of this part of the cord is to carry *to* the brain sensations generated in those parts in which the nerves are distributed, or to use the convenient scientific term, from the periphery. In the front, or anterior columns, the fibres pass upwards on the side they enter, and do not cross till they reach the medulla oblongata, the organ which connects the spinal cord with the brain. Their function is to carry messages *from* the brain to the periphery. The posterior or sensory nerves, and the anterior or motor nerves, are

separate for some short distance after leaving the cord; but they then join and pass out from the back bone as one nerve, which has the power of transmitting messages upward and sending messages downwards.

I think I have said enough in the meantime about the anatomy of the nervous system to allow me to proceed to the description of the brain, which is its great dominant organ. The model I hold in my hand represents the organ exposed by removal of the skull—you see it looks as if enveloped by a bladder—this membrane is called the *dura mater* or tough protector; immediately below this is a very fine membrane called the *arachnoid*, its extreme delicacy suggesting a spider's web; and next to the brain itself is another fine membrane called the *pia mater* or soft protector, which invests it very intimately. All these membranes pass through the great hole at the base of the skull to envelop the spinal cord. This second model represents the brain divested of all its coverings except the internal one, and this third one a brain perfectly exposed. In this condition its average weight in man is nearly 3 lbs., in women some ounces less; this difference is not to be explained by the smaller stature and bulk of women, for it has been shown that whereas the brain weight is nearly 10 per cent. less in woman than in man, the stature is only 8 per cent. less. It was supposed by Sir William Hamilton and others that the brain reached its full development as to size at the age of seven, but this idea is now entirely abandoned, and it is generally held that it does not reach its maximum weight till the twentieth year. It is true that in boys it arrives at fully $\frac{5}{6}$ths of its weight by the seventh year, and in girls $\frac{11}{12}$ths, which may, to some extent, account for the greater precocity of the latter, but the change which goes on in its constituents during the development of the remaining $\frac{1}{6}$th and $\frac{1}{12}$th, between the years of seven and twenty, are of a most important character. I had intended to speak of the statements lately made in certain journals as to the alleged diminution in size of the head within the last fifty years, but the fallacy of those statements was so thoroughly exposed in last Monday's *Scotsman* that I deem it unnecessary to reiterate the

arguments. I consider this article of so much importance that I purpose republishing it with this lecture.

The great anatomical divisions of the brain are not difficult to demonstrate. As I hold the model in my hand with its upper surface exposed to your view, you see a great mass of twisted and apparently irregularly arranged matter of a greyish pink colour, and when we examine the base of the organ we see the same type of arrangement existing there, except at the lower and back part of it, where we have a striped double mass. The upper twisted convoluted organ is the *cerebrum*—the great brain—*the* brain, and the inferior small striped organ is the *cerebellum* or little brain. You will notice a long mass projecting in front of the cerebellum, this is the *medulla oblongata* or oblong marrow (oblong in contradistinction to the long round spinal marrow); it is continuous with the spinal cord; and in front of it a transversely striped mass, called the *pons Varolii*, or Bridge of Varolius. I shall avoid technicalities as far as I am able, but for our mutual convenience I must ask you to remember the four terms—*cerebrum*, *cerebellum*, *medulla oblongata*, and *pons Varolii.* When I remove the three latter organs you will see at a glance how thoroughly the great brain deserves its name; it is with this organ, the cerebrum, that I have mainly to do to-night.

The cerebrum is divided into two equal halves by a great fissure called the *great longitudinal* fissure; these halves are called the *hemispheres* of the brain. These are made up of apparently complicated structures, convoluted worm-like organs which twist and turn over its entire surface. But in point of fact the arrangement of these organs, which are called the *convolutions*, is pretty definite, and the anatomist has by careful study been able to arrange them into divisions or *lobes*, and to assign to each convolution a separate name. Moreover, the physiologist and pathologist have noted phenomena which point to different functions being localised in certain areas.

I will not go further at present into the nomenclature of the divisions of the brain than to state to you that the anatomist speaks of the *anterior*, the *middle*, the *posterior*, and the *tempero-sphenoidal* lobes.

The convolutions dip deeply into the substance of the organ;—this you cannot see in a model, but if you look at this brain which has been hardened in spirit, you will notice that they form deep furrows. On the depth of these furrows, and on the tortuosity and complexity of the convolutions is believed to depend, to a very great extent, the potentiality of high intellectual development; for in the brains of the inferior races of mankind the convolutions have been found very simple and shallow, whilst in those of distinguished men they have been generally observed deep and complex; and as we watch the scale of intelligence in the lower animals we find complexity of brain arrangement as we ascend. The purpose of the convolutions seems to be the extension of superficies on which to extend the more active structure of the brain, viz., the grey matter.

When we slice off a portion of the brain and expose its interior we notice a very distinct and definite difference in the appearance of its structure. There is a great central mass of a glistening white substance which is bordered all round by a layer of pinky grey matter which dips into the fissures and into all the furrows between the convolutions—it is about $\frac{1}{2}$ an inch in thickness. The difference in colour between these two matters is due first, to the much richer supply of blood to the grey than to the white matter; and second, to the presence in the grey matter of those most important bodies the *brain cells.* Both matters are composed of blood vessels, neuroglia, and nerve fibre, but *nerve cells exist only in the grey matter.* These bodies which are found in incalculable numbers, probably in hundreds of thousands, vary in size, but the largest of them is invisible to the naked eye; they consist of finely granular protoplasm, *i.e.*, the simplest form of matter known to science; they vary somewhat in shape, those of the brain being mostly globular or pear shaped, appearing triangular when cut through lengthwise; those in the spinal cord being irregular in shape, presenting this appearance under the microscope (fig. 1). Each contains a *nucleus* or kernel, which again contains a *nucleolus* or little kernel. They are arranged in layers of from four to six in number and are supported in position by the neuroglia. I have twice used the adjective "most important" when speaking of

these bodies; and, for this reason, we have the best reasons for believing that they are the organs through which impressions from

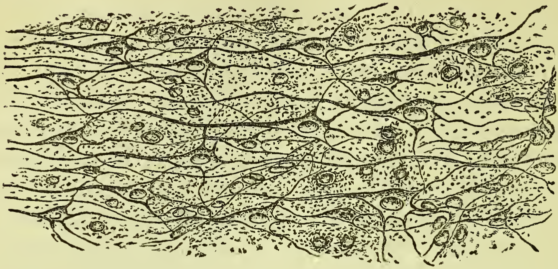


Fig. 1.

without are appreciated, that through their vital properties we see, taste, hear, smell, and feel, and that in them is generated and stored up what we, in our ignorance, term nerve force, and from them is discharged what we, in our ignorance, term nerve energy. For the purpose of immediate illustration let me adduce three experiments in confirmation of these statements—(1) When we irritate the surface of the skin a sensation of pain is produced which is referred to the part injured, but which really exists in the brain; for if we cut off the nerve connection between the part and the brain no sensation is experienced however much the part may be irritated. The brain is therefore a perceptive centre. (2) When we *will* to move a limb, under ordinary circumstances the limb obeys the stimulus of the will and movement ensues; but if we destroy any part of the nervous apparatus connecting the brain and the limb, no effort of will can produce action. The brain is therefore the organ of volition. In the first instance the results of irritation cannot be carried *up* to the brain, and in the second the stimulus of the will cannot be carried *down* to the limb; (3) When the grey matter of the convolutions is removed or injured by extensive disease the subject of experiment becomes more and more dull and stupid until at last all indications of perception and volition disappear. Comparing it to an electric telegraph whose apparatus is at fault, in the first experiment

the indicating needle is useless; in the second the manipulator may work the handles as energetically as he will, but without result, in both instances because the connecting wires are injured; and in the third experiment the cells of the battery are removed.

Let us now inquire what is the arrangement of the connecting apparatus. As I have shown you, each hemisphere of the brain consists of masses of grey matter and of masses of white matter. The grey matter is arranged in *ganglia, i.e.*, aggregations of nerve matter containing nerve cells. These ganglia are two-fold—1st, the grey matter of the convolutions forms two great ganglia called the *great hemispherical ganglia*, covering the whole surface of the organ, and 2nd, in the middle of the brain or rather nearer its base there is a series of such ganglia. The scientific terms applied to these are *optic-thalami* and *corpora striata;* but I shall speak of them as the *basal ganglia.* The grey matter of these basal ganglia is in direct anatomical connection with the grey matter of the spinal cord, which differs from that of the cerebrum in that it lies in the centre surrounded by white matter. In the spinal cord the white matter is external. We have already traced the course of the fibres in the cord. Remembering that the function of the anterior fibres is downward and that of the posterior upward, we will, for the purposes of anatomical description, trace them from below upwards. In their course to the brain they are connected with the cells of the grey matter of the cord; passing through the medulla oblongata, and pons Varolii, they run towards the basal ganglia, some of them passing right through, whilst others terminate in the great nerve cells of those organs, and are thus interrupted in their continuity; but they start afresh to pass on with the uninterrupted fibres in their course to the grey matter of the hemispheres. From the basal ganglia the fibres spread out like a fountain, or like the sparks from a firework—they radiate, or are projected towards the dome of grey matter, and are in consequence termed the *corona radiata*—the radiated crown, the *projection series* of fibres. By this means we have direct communication established between the furthest extremities of a nerve and the hemispherical

ganglia. An ounce of demonstration is worth a pound of description in dealing with such a difficult subject, and I do not think I would have ventured to speak about it were it not that I had it in my power to lay the actual thing before your eyes. This I am enabled to do by the kindness of Dr Hamilton, Pathologist to our Royal Infirmary. This large slide contains a very thin section or slice of a human brain. By a marvellously ingenious process devised by himself, Dr Hamilton is able to cut a slice so thin as to permit of the passage of light, and therefore to cast on a screen the images of its various structnres. What I am about to show you is a slice made through the entire substance of the organ as nearly as possible in the middle line from before backwards.

[Here a longitudinal vertical section of the brain was thrown on a screen 20 feet square, showing in detail what is seen in diagram No. 2.]

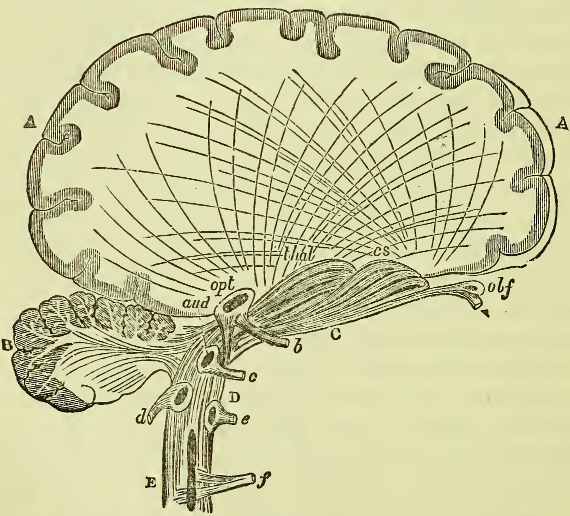


Fig. 2.

But you will ask how does fibre communicate with cell, Looking at this model of a cell we see that it has various filaments

projecting from it; these are called the *Poles.* Cells are termed *unipolar*, *bipolar*, and *multipolar*, according as they possess one or two or many projections (see fig. 1). The poles at the base are termed *basal*, those at the apex *apical*, and those starting from the sides *protoplasmic.* Now the basal pole is continuous with the axis cylinder of the nerve fibre, which I told you is the medium through which impressions are conveyed in the nerves. According to certain authorities the poles at the apex are continuous with a horizontal series of fibres on the surface of the convolutions, and it is also believed that cell communicates with cell by means of the protoplasmic poles.

So much for the connection of the brain with the rest of the nervous system; but we must revert to the models again for a few minutes to show another important connection, that between the two hemispheres. Every part of the nervous system is double: there is a right and left cerebrum, cerebellum, medulla oblongata, and spinal cord, and each of these lateral halves is in direct communication with the other. The nervous centres are double organs, and are associated together by nerve-fibres. I ask you to accept this statement as far as it concerns the other organs, but I am able to demonstrate it to you in the case of the brain by another of Dr Hamilton's wonderful sections. Deep as the great longitudinal fissure is, it does not cut the cerebrum entirely in two. At the bottom of the cleft there is a mass of transverse fibres called the *corpus callosum*, or hard body. This is the most important commissure of the brain. The derivation of the word commissure, *committo*, to bring together, indicates its function. Through it pass nerve-fibres which can be traced from the grey matter of each hemisphere, bending in the form of an arch (and therefore termed *arcuate* fibres), to the corpus callosum, passing through which, they course to the grey matter of the hemisphere opposite to that they start from, and reach it at an exactly corresponding spot—identical portions of each hemisphere are thus connected.

(Here a transverse vertical section was shown, illustrated by diagram No. 3).

Thus we have, by means of nerve-fibre, a perfect system of

association—by the radiating fibres the spinal cord is in direct connection with the cells of the grey matter of the brain, and by

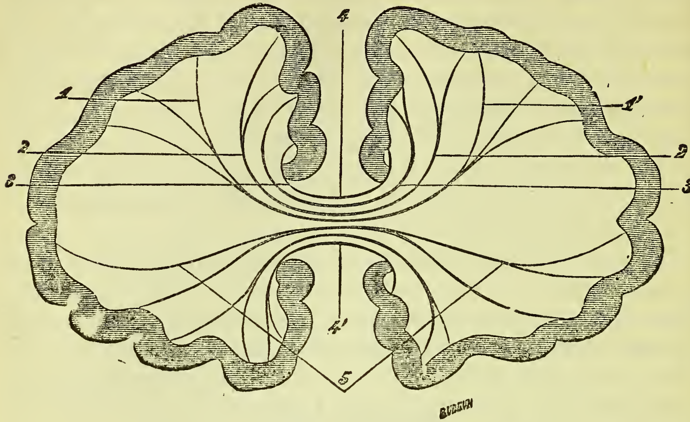


Fig. 3.

the arcuate system the cells of opposite hemispheres are brought into intimate relation one with the other.

I will now direct your attention to the blood-supply of the brain. From its constant activity, the brain demands a large amount of blood to nourish and restore its elements. In point of fact, nearly 6 per cent. of the total blood is at work in the brain: and if we consider that about 64 per cent. of the blood is circulating in the heart and large vessels, and only some 36 per cent. in the tissues of the body, we gain an idea of how richly the brain is supplied. Time will not permit of me going into the interesting subject of the arrangement of the brain blood-vessels. Suffice it to say that it is devised with the objects first of insuring not only a very copious supply, but also a very uniform and equal flow of the nutrient fluid, and secondly, of protecting it, as far as possible, from influences from without. The results of the stoppage of a cerebral vessel are most disastrous—the functions of the part supplied are at once arrested, and unless the obstruction is removed the tissues become permanently disorganised. The con-

volutions are nourished by vessels which enter from their outer surface, certain of which pass on to the white matter. But the blood-supply is five times greater to the grey than to the white matter, an additional evidence, if such were necessary, that the former exercises much more functional activity than the latter.

You will remember that I pointed out to you at the opening of this lecture that the brain is contained in a hermetically sealed cavity of rigid bone, and that the quantity of matter in this cavity must always remain the same. Now, unless some provision exists for differences in the amount of blood in the brain, it follows the amount of blood must remain invariably uniform. And this was for long believed to be the case. But experiments have shown that this is not true, that, although the total amount is pretty uniform, still, under certain circumstances, the quantity of blood varies. This is markedly so in the condition of sleep—it has been reduced to demonstration that during sleep the amount of blood in the brain is diminished. How, then, is compensation procured for the withdrawal of blood, and what material is displaced if a greater quantity than usual is introduced? This compensation is procured by the *cerebro-spinal fluid.* You know the brain contains 75 per cent. of water: under circumstances of blood-pressure, a certain portion of this water becomes rapidly absorbed or displaced, and when blood is withdrawn a portion corresponding in bulk to the abstracted blood is rapidly drawn into the cavity of the skull. "Hence we may consider that the cerebro-spinal fluid in the interior of the skull not only subserves the mechanical functions of fat in other parts as a packing material, but, by the readiness with which it can be displaced, provides the means whereby undue pressure and insufficient supply of blood are equally prevented" (Kirke's Hand-Book of Physiology).

The consideration of the chemistry of the brain will not detain us long, for really not very much is known about it. The nervous tissue contains substances closely allied to albumen, which, as you know, is the chief constituent of the white of egg, a substance which coagulates when mixed with alcohol. But I do not think any physiologist would venture the statement made by a dis-

tinguished teetotal lecturer last year in this city, that these albumenous substances contained in the brain become coagulated by the drinking of spirits. Were it true that when alcohol is introduced into the system the albumen of the brain coagulates, the brains of a very large proportion of our countrymen would be in a condition identical with that of hard-boiled eggs; and although the Scot is generally regarded as a hard-headed man, his hard-headedness hardly amounts to this. The lecturer I allude to reduced his statement to demonstration. He placed in a glass vessel a certain quantity of white of egg, which he told his audience was identical with certain substances contained in the brain. He then poured in a glass of whisky which, of course, produced coagulation, and he drew the deduction that the same result obtained in the brain when it was under the influence of alcohol introduced into the system through the stomach. It is a pity that a good cause should be marred by such misrepresentation. Supposing I were an anti-teetotal lecturer, I could equally easily, and equally inaccurately, quote chemistry for my purpose in denouncing tea. I should say to you :—"Ladies and Gentlemen,—Dr Foulis in his lecture last year on the blood told you that it contained a considerable amount of iron. You are in the habit of thinking tea is a harmless beverage, but mark this experiment :—in this jar of water is a small quantity of a solution of iron ;—observe the dreadful results when I add to it a cup of tea —it converts it into ink by virtue of its tannin, and it acts in a similar manner on the blood!" I beg to assure you, however, that both statements are equally incorrect. Alcohol does not harden the brain, on the contrary, it softens it; and tea does not convert the blood into ink. I wonder if this lecturer would be surprised to learn that, do what we will, a true alcohol exists in every brain. In the nervous tissues of the most conscientious teetotaler an alcohol called *cholesterin* is to be discovered in considerable quantity. He would probably say that if such is the case there is no reason for adding more, and, unless under exceptional circumstances, I am inclined to agree with him.

With this very rough statement of the anatomy and structure of the brain, we pass on to consider its functions. Certain of

these have been already alluded to. I am only going to speak of the functions of the cerebrum, leaving those of the cerebellum and the medulla oblongata either to another occasion or to another lecturer. The functions of the cerebrum are thus summarised by Kirke:—"(1.) The cerebral hemispheres are the organs by which are perceived those clear and more impressive sensations which can be retained, and regarding which we can judge. (2.) The cerebrum is the organ of the will, in so far at least as each act of the will requires a deliberate, however quick, determination. (3.) It is the means of retaining impressions of sensible things, and reproducing them in subjective sensations and ideas. (4.) It is the medium of all the higher emotions and feelings, and of the faculties of judgment, understanding, memory, reflection, induction, imagination, and the like."—("Handbook of Physiology," Kirke.) These conclusions have been arrived at (1.) by the observation of the facts of comparative anatomy, which show that as we ascend in the scale of the animal kingdom, with increased development of the brain we have an increase of intelligence, till on reaching man we find the most perfect type of brain; (2.) by the careful study of the symptoms of disease of the brain; and (3.) by experimentation. The subject of progressive development is most interesting, but I cannot allude to it further now than to point out the characteristic of the human brain which serves to distinguish it from those of the rest of the animal kingdom. This is that in it only the posterior lobes are so fully developed as to overlap the cerebellum. Even in the higher apes in which the type approaches most nearly to that of man, the back part of the brain is much less perfectly formed, and the cerebellum can be seen when the organ is viewed from above.

But the most definite proof that the cerebral hemispheres are necessary for the production of those phenomena which we term intelligence and will, is based on data procured by the observation of their injury by disease, or by the hand of the physiologist. Every one knows that a violent blow on the head produces unconsciousness, and that mental function is in abeyance when blood is effused on to or into the brain, producing apoplexy. But these

are but coarse experiments, and the physiologist has been obliged in order to elucidate important facts bearing on the treatment of disease to submit animals to experiment. He has found by this method that when the grey matter of the superior convolutions is removed, intelligence and voluntary movement are put an end to—that all spontaneous action becomes impossible. A frog, the upper part of whose brain has been removed, continues to breathe, and is even able to move his limbs when irritation is applied to them, through virtue of the functions of the spinal cord and medulla oblongata, which are themselves independent nervous centres—independent to this extent that they are able to transfer impressions from the posterior or sensory columns to the anterior or motor columns, without sensation being conveyed upwards to the brain, and yet motion being produced. This is termed *reflex action.* But as I have already stated to you, if the grey matter of the convolutions is destroyed, or if the connection between the brain and the spinal cord is severed, feeling cannot be experienced and the will becomes inoperative. I do not think it necessary to prolong the argument, as sufficient has been said to enable you to give a reason for your belief, that the possession of a brain is necessary for the manifestation of mental phenomena—that it is in fact the organ of the mind. What the nature of the processes is through which these phenomena are produced we are entirely ignorant. As Hermann says, "in a part of the central organs, the cerebral convolutions, certain material processes are accompanied in an inexplicable manner with wholly indefinable phenomena, which characterise what we term consciousness. The term mind may be applied to the combination of all the actual and possible states of the organism."

Nothing is definitely known as to whether any of the mental functions are localized in any particular part of the brain. It is highly probable that such is the case; but science has not as yet been able to produce any substantial proof. You may feel quite certain, however, that the so-called science of phrenology is based on entirely fallacious data. The idea that the skull can be mapped out into small areas indicating the mental function of the subjacent brain, is entirely false. If we look at a brain

covered by its tough outer membrane we see that it is as devoid of irregularities on its surface as a bladder of lard; and if again we inspect the inner surface of the skull cap we find that if it has any depressions they do not correspond with elevations on its outer table. The phrenological images which are still sold in the shops may be regarded as the Fetishes of an extinct faith. I wish I had time to tell you of the work which is being done by many earnest physiologists, who are striving hard to arrive at accurate conclusions as to the localisation of brain functions. It is a question of the utmost importance to medicine, and already many valuable observations have been made; but so long as the physiologist has his hands tied by legal enactments the interests of the healing art must suffer and mankind with them. Let me remind you of what was once said by the highest authority in morals—"Ye are of more value than many sparrows."

I will only instance one or two of the results obtained in this direction. Fritsch and Hitzig in Germany, and Professor Ferrier in this country, have found that the stimulation of various circumscribed areas on the surface of the convolutions (which till lately was believed to be insensible to irritation) is followed uniformly by movements of particular limbs,—for instance, if a mild current of electricity is applied to one spot, the leg is moved; if to another, the eyes; if to a third, the neck, muscles of the face, and so on. Ferrier, indeed, has by patient inquiry mapped out the various areas which he holds to be centres from which, in the phenomena of voluntary movements, influences pass to special groups of muscles; and he has continued his investigations in the direction of destroying these centres, and has found that paralysis of the muscles which contract on the irritation of electricity, is the result. I admit that this line of investigation was first suggested by the observation of disease. Broca of Paris noted the uniform coincidence of destruction of a small area of an anterior convolution of the left side with loss of speech; but this observation merely opened up a field of inquiry most important in its relation to medicine and physiological science, which could not have been tilled if the physiologist had not submitted animals to experimentation, nor, in fact, could any of the

physiological facts I have adduced to you to-night have been verified or reduced to demonstration without vivisection.

In conclusion, allow me a few minutes to indicate the practical outcome of this lecture. Having now before you some of the great facts connected with the constitution and arrangement of the tissues of the brain as they exist in health, it will be all the more easy for you and for me to consider together on a future occasion the effects produced upon them by malign influences. My hope is that the demonstrations of to-night will help you to recognise the truth of the theorem, *that we have a right to presuppose that in the brain, as in other organs of the body, the normal exercise of function is dependent on a perfect maintenance of the anatomical relations of the component structures.* Believe me, this position is not by any means universally accepted; the world is only too apt to regard many of the phenomena of brain disease as mere perversions of function, independent of structural change: few men, for instance, appreciate that that most awful calamity, madness, is dependent on material morbid processes—that it is a disease. Lunacy is regarded more as a psychological curiosity than as an indication of a diseased condition. I expect to be able to demonstrate to you the structural nature of many of the morbid conditions which are produced by certain of our habits of life; and when I address you on the subject of Brain Health I shall feel something under my feet when speaking of the evil effects of neglected or of over education, of over work or of idleness, of alcoholism, of over and of under feeding—"Brain cell," "nerve fibre," "neuralgia" will not be mere terms, but will convey to your minds something palpable; you will know that they are structures which may be put out of gear just as any other structure of the body may be; "nerve exhaustion" will not be a mere form of speech. There is perhaps no organ of the body over which we can of our own free will and accord exercise so much influence for good or for evil as the brain; we can to a great extent make it or mar it, and in marring it we mar the whole system, *for on the normal exercise of brain function depends the permanent exercise of the function of every structure of the body.* And remember this—the brain cannot, like the lungs, the liver, the

skin, or the kidneys, cast any of its functions on other organs—it is, so to speak, self-contained—it can gain no relief in disease from vicarious aid; it must do its own work, rid itself of its effete matter and of the products of injury or disease, and provide within itself for the resumption of functions, the exercise of which has become impaired from whatever cause.

We see daily the evil effects of overstraining the powers of the brain. Many sources of overstrain are beyond our control. In the hard battle of life man must work hard to gain a living, and often under circumstances prejudicial to brain health. But mind you the brain is a long suffering organ as far as work is concerned. It is not work but worry that kills it, and worry is not an influence we can often keep in subjection. But it is in the power of many members of the community to kill the brains of others by overstrain. It is very doubtful economy to overstrain thews and muscles, it is very false economy to overstrain brain cells, for on the action of these cells the proper use of the muscles depends. When a man has to concentrate his attention his brain cells are actively at work—work implies loss of tissue and constantly diminishing functional activity; therefore concentration of attention is limited. This is practically admitted in certain services —*e.g.*, the naval and military—in the former, a man's trick at the wheel does not exceed two hours, and in the latter the sentry holds his post for the same term. Except in time of war it does not very much matter about the soldier, but the sailor at the helm may, by a mistake, cause loss of life and property. Experience has thus demonstrated the physiological fact that, even under supervision of trained officers, human attention cannot, under ordinary circumstances, be relied on for more than a certain limited time when the safety of communities is at stake. But we are told this is disregarded in the service which most of all holds men's lives in its hands—the Railway service. We are told that railway servants are kept in the switch-cabin for many long hours at a stretch, wielding the instruments, the wrong use of one of which may wreck the train. This is an utterly unphysiological position in which to place any man, and the onus of evil consequences lies at the door of those who outrage the laws which

govern health. No individual or company can protect himself or themselves against the stupidity of mankind; but given a proved attentive servant who has to exercise monotonous duties, on the accurate performance of which the safety of the public depends—given in fact the very best conditions—it is worse than unwise to press his powers of concentration for more than a very few hours at a stretch. Railway servants should keep watch and watch; their trick at the switch, like that of the sailor at the wheel, should be two hours about. If under such circumstances they fail in their duty and kill men they may be held responsible—but not otherwise.

I wish you all good night, trusting that within the next two hours the supply of blood to your brains may be diminished, and that sleep will ensue in accordance with physiological laws, and that you will all rise strengthened by repose and ready to receive the health-giving influence of the God-ordained day of rest.

HEAD MEASUREMENTS.

The Scotsman, December 5, 1881.

The brain is universally recognised as the organ of mind, and the size of this organ is very generally taken as an index of mental capacity. Big brains have come to be suggestive of great minds, while it is an undoubted fact that the possession of a brain which falls below a certain minimum standard of weight implies idiocy on the part of its unfortunate possessor. M. Broca places the lowest limit of brain-weight compatible with human intelligence at 37 oz. in males, and 32 in females, the average brain-weight of Europeans being about 49 oz. Whether the possession of more than the average quantity of brain implies the presence of more than average intelligence is a question that has given rise to much discussion. It is an undoubted fact that very high brain-weights are occasionally found in people whose mental acquirements are certainly not above the average. Out of 157 brain-weights of adult Scotsmen, Dr Peacock found that four, all belonging to artisans, who, so far as could be learned, had not been distinguished above their fellows by superior intellectual endowment, weighed over 60 oz. each, while the heaviest brain on record—it weighed 67 oz.—belonged to a bricklayer. Dr Morris, who chronicled the case, was told that the man "had a good memory, and was fond of politics; but that he could neither read nor write." Whatever his potentialities might have been, "it is evident," says Dr Morris, "that his actual acquirements were not great." The non-development of superior mental power in such cases may, however, be attributable not to lack of capacity for learning, but to the absence of the conditions necessary to its growth. Certain it is, that among the educated and intelligent

classes the number of big brains is greater than with uneducated and less intelligent people. Among the latter, the proportion of brain-weights above 55 oz. has been ascertained to be only from 4 to 6 per cent, while the proportion among men who have been distinguished for great intellectual acquirement is at least 23 per cent. The brain-weights of only 23 such men are accurately known, and it is from these that the above proportion has been obtained. With few exceptions, these were all above the average capacity of 49 oz. First in this respect comes the celebrated naturalist Cuvier, with a brain-weight of $64\frac{1}{2}$ oz., followed by the famous Scottish physician, Abercromby, and the poet Schiller, each with 63. Goodsir, the anatomist, follows at a considerable distance with $57\frac{1}{2}$, Sir James Simpson with 54, and Chalmers with 53. That such men as Gladstone, Bright, etc., possess more than average brain-weight may be inferred from a statement lately made public of the size of hat worn by these and a number of other living or recently deceased statesmen and litterateurs. Premising that what is known to the trade as size 7 is that of the average head, with presumably 49 oz. of brain, and that $7\frac{5}{8}$ is a size so large as only to be made when specially ordered, it appears that out of fourteen persons whose hat-sizes are given, two (Lord Chelmsford and Dean Stanley) were below, while other two (Lord Beaconsfield and the Prince of Wales) were exactly up to the average. Of the others, Dickens, Selborne, and Bright required $7\frac{1}{8}$, Earl Russell $7\frac{1}{4}$; Lord Macaulay, Gladstone, and Thackeray, $7\frac{3}{8}$; Louis Philippe, $7\frac{3}{4}$; and the Archbishop of York, 8 full! Of the twenty-three distinguished men already referred to whose actual brain-weights are known, four, including the late Professor Hughes Bennet, aud Hermann, the philologist, were distinctly below the average, showing, as Dr Bastian points out in a recent work, that "a well-constituted brain of small dimensions may be capable of doing much better work than many a larger organ whose internal constitution is, from one cause or other, defective." When there is no such defect, however, the big brain, there is every reason to believe, confers an undoubted advantage on its owner.

Such being the case, it is not surprising that the assertion

recently made, that a sensible diminution had taken place of late years in the size of the heads of the male population of those islands, and consequently of the brains—for in health the brain always fills the skull—should have attracted attention. The data upon which this startling statement is founded have been supplied by the most persistent, if not the most scientific, class of head measurers—the hatters, whose evidence on the point is of the most circumstantial kind. One merchant, of large experience, states that of the six sizes of hats beginning at 21 inches, and increasing by one-half inch to $23\frac{1}{2}$ inches, he was in the habit, five-and-thirty years ago, of buying for his retail trade in the following ratio, beginning at 21 inches—viz., 0, 1, 2, 4, 3, 1, while at the present time he is selling hats in the following ratio—viz., 3, 4, 3, 1, 1, 0. In other words, where only one hat was required, thirty-five years ago, at or under $21\frac{1}{2}$ inches he now requires seven; and where formerly four of the two largest sizes were required, he now only needs one. From numerous letters which have appeared in *Nature*, the experience in this instance would appear to be that of the trade generally. One manufacturer writes—"I should say that heads generally are two sizes less than at the time (thirty to forty years ago) you refer to; a head of more than 24 inches circumference is now quite a rarity, whilst we make thousands of hats for heads with a circumference of about 21 inches." The decrease, according to another manufacturer, is so general "that we do not make big-sized hats for stock, but only as ordered, and very few then." That a similar diminution has taken place in Scotland is the experience of one of the principal hatters in Glasgow. There can be no reasonable doubt, therefore, that our hats are, on the whole, smaller than they were a generation ago; do smaller hats, however, in this case imply diminished heads? It has been pointed out that the undoubted diminution is probably to be explained by a reference to change of fashion in the mode of wearing both hat and hair. Thirty years ago it was customary, as the prints of the time show, to wear the hat drawn well down over the head how far over may be judged from the fact that it was customary, in England at least, to attach a piece of cloth to the under side

of the brim at the back in order to take the friction off the coat-collar. On the other hand, the hair was worn thick and long, the present style of close-cropped hair being in those days associated with soldiers and prisoners. These two causes together seem fairly adequate to explain such decrease in the size of hats as has been noticed. If inadequate, as certain correspondents in *Nature* maintain, the only alternative is to believe that, in the course of little more than a quarter of a century, the heads, and consequently the brains, of our male population have sensibly diminished. That this is in the last degree improbable will be the opinion of every student of recent anthropological science.

In a progressive civilisation such as prevails in this country and throughout the greater part of Europe and America, there is reason to believe that the cranial capacity of the population is, on the whole, increasing rather than diminishing. Owing to the want of early observation, it is difficult to institute comparisons between past and present. An opportunity, however, lately occurred in Paris which was taken advantage of by M. Broca. In digging the foundation of a new building a vault was opened containing a large number of human skeletons, whose surroundings proved them to have lived not later than the twelfth century. M. Broca found the average capacity of 115 of those twelfth century skulls to be 1426 cubic centimeters; while another series of skulls—125 in number—taken from a cemetery belonging to the early years of the present century, gave an average of 36 cubic centimeters more. The average Parisian skull would thus seem to have increased considerably in capacity during seven centuries of progressive civilisation. That this increase has gone on slowly but surely as man progressed from barbarism to civilisation may be inferred from a study of the cranial capacities of the various human races. Thus, while the brain capacity of the European amounts to 94 cubic inches, it is only 91 in the Esquimaux, 85 in the negro, 82 in the Australian, and 77 in the Bushman. These are merely averages, and, as such, do not bring out the important fact lately noticed by Le Bon, that among the lower races the limits of variation in the cranial capacity of individuals of the same sex

are much less extended than in the higher races. Thus, among modern Parisians large and small skulls vary by about 600 cubic centimeters, while negro skulls vary only by 204, and ancient Egyptian by 353 cubic centimeters. Another important difference in the cranial capacity of the higher and lower races is connected with sex, and serves to throw light upon the influence of mental exercise in increasing brain capacity. According to Professor Bischoff, of Munich, in a recently-published work, the difference between the average brain-weight of men and women is $10\frac{1}{2}$ per cent. Much of this is undoubtedly due to difference in stature, a tall person having, *cæteris paribus*, a larger brain than one less in height; partly, however, it is attributable, there can be little doubt, to inferior mental training. Among the lower races, where the women have not only charge of the offspring, but have also to share, and that largely, in the husband's occupations, the brain capacity of the two sexes shows much less difference. The difference, according to Le Bon, between the average capacity of the skulls of male and female Parisians is almost double that found to obtain between the skulls of the male and female inhabitants of Ancient Egypt. Civilization, by giving increased exercise, especially to the male brain, has, there is good reason to believe, gradually produced that increase of brain capacity which now distinguishes the civilized from the savage races of mankind. Nowhere has this influence been more conspicuous than in China, whose culture, if not of the most advanced kind, has the advantage over all others in the great length of time it has endured. The Chinese are, as might have been expected, a big-brained people; indeed, the only statistics of Chinese brain-weights available show them to exceed all other nations in this respect. A few years ago the brain-weights of 11 adult male and of 5 female Chinese—the chance victims of a great typhoon at Hong-Kong—were obtained. These belong, with one exception, to the coolie or lowest grade of Chinese society, yet the average brain-weight of the males reached $50\frac{1}{2}$ oz., and that of the females $45\frac{1}{2}$ oz. This is an average not attained, so far as yet known, by any other nation, it being fully 6 oz. above that of the average negro, $1\frac{1}{2}$ oz. above the European,

and ½ oz. above the average Scotsman. That civilisation has been the main cause of increase in the size of the brain there can be little doubt. To admit, therefore, that the heads of the British people are now growing smaller, would be to confess that the resources of civilisation were indeed exhausted, and that, as a people, we had begun a retrograde journey towards the barbarism from which we originally emerged.

THE SKIN, AND ITS MANAGEMENT IN HEALTH.

By Dr W. ALLAN JAMIESON.

In order to protect the delicate structures of which the body of man and the higher animals consist from rude contact with the external world, it has been sheathed in a tough yet sensitive and elastic covering, which is known as the skin, and I propose this evening to tell you something of its construction, as well as to point out what are the various functions or offices which are performed by it, as one and an important part of the living body, and also how to treat it so as to maintain it continuously in a condition of healthy activity, as well as to prevent its becoming as far as possible the prey of disease.

Simple though the skin appears to be, it is a complicated organ, but we may speak of it under three divisions. 1*st.* The skin proper; 2*d.* The glands contained within it which supply oil and perspiration; and 3*d.* The appendages which it bears—the hairs and nails.

The outer surface of the skin is comparatively dense and hard, so as to resist the more or less destructive influences of weather and occupation. It is known as the cuticle or scarf-skin, and is constructed of an infinite number of thin horny plates or scales, laid one on the top of another, and firmly attached except on the very surface, where they become gradually loosened and are constantly being cast off. This shedding of the outer layer of the skin is nearly imperceptible in health. It is this which makes up most of the cloud of dust, which flies off when a stocking is shaken, after having been worn a few days. This bran-like powder consists mainly of horny plates which have done their

duty, have become dry, old and useless, thus loosen, and fall off. The thickness of the horny layer varies in different parts; it is thickest on the soles of the feet and palms of the hands, thinnest on the eyelids.

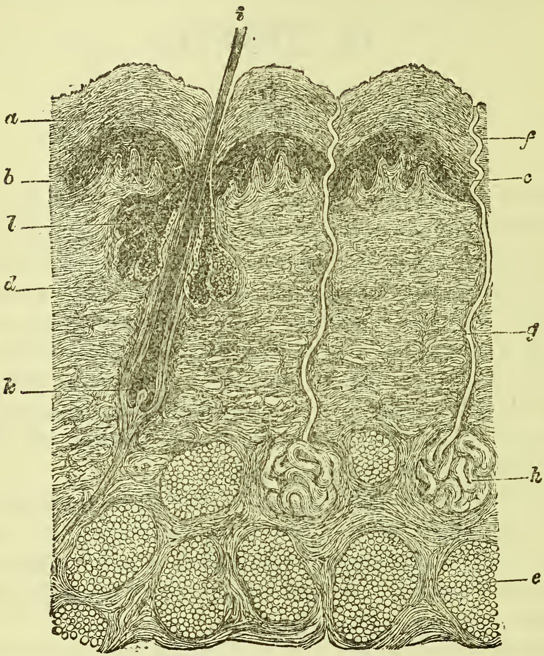


Fig. 1.

Section perpendicularly through the healthy skin. *a.* Epidermis or cuticle, *b.* mucous layer with pigment, *c.* finger-like projections of true skin, *d.* true skin. *e.* fatty masses, *f.g.h.* Sweet gland and tube or duct. *i.k* Hair, with its follicle and papilla. *l.* Sebaceous gland attached to hair follicle.

Underneath this layer the skin is more succulent and soft, and is made up of numbers of bodies called cells, each actively growing, united to one another by a transparent cement substance, and further joined in the deeper layers by fine spines or prickles, which project from their surface and interlace. This layer is called the mucous layer, and just as the mucous membranes of

the inner surfaces of the body secrete or form a peculiar watery fluid called mucus, which keeps them moist and ready for the duties they have to carry out, so the mucous layer of the skin secretes the outer horny covering which lies above it and protects it. It used to be thought that these actively growing cells became themselves changed into the horny outer plates, by a gradual process of change. The most recent researches shew that such is not the case, but that the outer cells are distinct from those deeper, and secreted or produced by them, not merely themselves become thin, dry, and hard.

The colour of the skin, brown, black, olive, or white, is due to the shade of the deepest cells of the mucous layer. These, only slightly tinted in the white races, are much more intensely so in the dark. Both heat and light tend to increase the proportion of colouring matter in the skin, hence the bronzed face of the soldier who has been exposed to the Indian sun, and the brown patches on the front of the legs of furnacemen and others, who stand for hours before glowing fires, though protected from its light by their clothes.

Still passing deeper we come to the true skin, that part which in animals, when tanned, gives body to leather, which contains those fine tubes, whose office it is to convey to it its supply of nutritive fluid—the blood. Suited to its requirements, this part of the skin is made up of a mesh work of fine fibres, which interlace so as to compose a structure like felt, tough yet elastic. Within this the bloodvessels branch and divide with ease, and are sustained and separated. It is delicate and close on its external part where it underlies the mucous layer; looser and more open deeper down where the sweat glands and roots of the hairs are embedded in it. The openness of texture of the deep portion gives the secreting part of the glands room, permits the skin as a whole to move, and it is in this part that water accumulates in dropsy. The surface of this true skin is not smooth; it rises into points or prominences which, like so many fingers, push themselves into the mucous layer, and thus bring the ends of the nerves nearer the exterior of the skin, so that we can feel with greater exactness, and also a larger surface is obtained than if

thoroughly in the future for the important duties which, as wives and mothers, they may be called upon to fulfil.

Diseases of the joints are of very common occurrence; and in many instances these conditions are aggravated or rendered serious by the want of a little care and attention at the commencement of the affection. Although a weak or unhealthy state of the constitution may cause joint disease, most frequently some injury is the active agent in producing the condition. Even a slight injury of a large joint may, if care is not taken, be followed by disease; and therefore, when a child receives any hurt to a large joint, precautions should be employed to prevent this risk. The principal precautions to be taken are:—(1.) To keep the injured joint perfectly at rest; (2.) to apply warm and soothing fomentations to the injured part; and (3.) to consult a medical man as to the condition. When a child complains of pain in a bone or joint, and is seen to move the limb or joint with stiffness or difficulty, a medical opinion should be obtained without delay; for, if the case is one of joint disease, the want of treatment for even a day or two may cause the condition to become aggravated or serious. Should medical aid not be at hand, it would he a wise precaution to keep the injured joint at rest until it is obtained. It is well also that you should know that diseases of the joints are often tedious, and may require prolonged care and treatment.

A few Words on our Royal Infirmary.—In concluding these practical hints, I ask your leave to make a very few remarks on our noble Infirmary.

This is neither the time nor the place to appeal to you for money, but I have no hesitation in asking you for your sympathy and confidence in connection with this institution. I know that hard words are occasionally used, and unpleasant impressions sometimes arise in regard to the work which is done there, and much pain is given to my colleagues and myself when such words or impressions come under our experience, more particularly as we feel that we freely give our time and energies to the performance of the various and laborious duties which as physicians and surgeons we are called upon to perform. When I remind you that

from 16,000 to 18,000 patients are every year treated by us, it may assist you to understand the amount of work which is performed, and it will also, I hope, explain to you how it may sometimes, but quite exceptionally, happen that a patient is apparently treated with carelessness and neglect. I say apparently, because when these so-called cases of neglect are inquired into, it will usually be found that the circumstances depend either upon some misunderstanding, or are only such as may and do occur in any institution where so large and various a community is collected together.

However much, therefore, a few and inexperienced individuals may be prejudiced against the Infirmary, I know from large experience this fact, that not more than one or two in a thousand who have been patients, and experienced the benefits of the Infirmary, have any other feeling towards it and its medical staff than that of gratitude and appreciation. Some of you, perhaps many of you, have had friends in the Infirmary as patients, and I feel confident that their opinion and experience will confirm my statement. If any of you should hear opinions expressed unfavourable to the Infirmary, I ask you, as a duty, to inquire the reasons and foundations for such expressions. If they are founded upon true facts, bring these facts at once under the notice of the Infirmary authorities, and I am certain that they will receive proper attention. If no proper reasons or facts can be obtained, then you are also in duty bound to take the part of the Infirmary, and expose the fallacies of its detractors. The New Infirmary is open to you all, and as there are now no infectious diseases treated there, go with your wives and families, at the appointed hours, and see for yourselves the patients, their comfort, and their contentment.

Such a visit will do you and yours good in every way, and will aid in exciting and increasing your sympathy for your suffering fellow-men and women.

thing wrong. By the action of these little muscles, then, the body is maintained at or below the temperature of 98·5°. In saying this, however, I do not mean to exclude the bloodvessels themselves from bearing their part. The tubes of which they consist are both elastic and contractile, and they, as well as the muscles of the skin, are under the control of the nerves, which, partly influenced by the will, but more particularly automatically, induce their dilatation and contraction as the necessities of the body require. They thus regulate exactly the amount and proportion of nutriment conveyed in the blood to each portion of the skin, and maintain it in vigour.

There are implanted in the skin at various depths three species of glands. One of these provides perspiration or sweat, another an oily material, and the third hair. This latter is also looked on as an appendage of the skin, but, as will be seen, it may be regarded as much a secretion as the sweat is.

The sweat glands consist partly of a coiled-up tube lined with secreting cells, and planted deep down among the fatty substratum; partly of a long duct, also lined with cells, leading upwards from the coil; partly of a tunnel without any proper walls, which runs spirally through the upper layers of the skin. The openings of the sweat glands, which are set with considerable regularity, can be seen with a strong magnifying glass as little pits or depressions on the points of the fingers, between the ridges which occur there. These are what are popularly known as the pores of the body. Their total number varies in different persons, but has been estimated at in round numbers 2,300,000. From this estimate some conception of their importance may be derived.

The sweat, which is a compound fluid made up largely of water containing common salt in solution, also some fatty material, is continually being poured out. Though the openings on the surface are free no sweat can, when the body is at rest or not too warm, be seen to ooze from them. This is in consequence of the spiral arrangement of the outer part of the duct, by means of which the perspiration soaks the outer horny layer and keeps it pliant and moist, being thus imperceptibly exhaled from the surface, constituting what is known as the "insensible perspira-

tion." The total amount of watery fluid which thus escapes by the skin has been calculated at two pounds or pints daily. This is largely increased by exercise, warm weather or rooms, etc., and bears a direct relation to the quantity given off by the kidneys

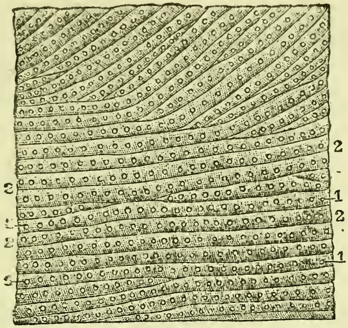


Fig 2.

Openings of the sweat glands on the palm of the hand. Magnified four times. 1. Openings of glands. 2. Furrows or ridges between the lines of openings.

and lungs. How important, therefore, it is that the perspiration when being freely poured out should not be too suddenly checked. When this happens the lungs or kidneys are called on to do increased work without due warning, and they and other internal organs, as the liver, stomach, and bowels, are liable to become all at once too full of blood and inflamed. When one is tired after exertion, and thus in a depressed and weakened state, and freely perspiring, should this evaporation from the surface be rapidly checked and dried by sitting in a current of air—a draught as it is called—some internal organ becomes congested and we "catch a cold." Hence arise jaundice, acute indigestion, diarrhœa, as well as inflammation of the lungs or kidneys. This may sometimes be warded off by again quickly restoring the action of the skin by a hot bath, combined it may be with a tumbler of toddy. In most cases the mischief has been done ere this is resorted to.

It is thus seen how completely in harmony all the functions of the body work together in a condition of health. In cold weather

the skin is least active, more water is given off by the lungs and kidneys, consequently there is more danger should inflammation then attack them. Again, in summer the skin pours forth its watery excretion more abundantly; this, in evaporating, cools down the surface and maintains the uniform temperature of health, while the kidneys often secrete more scantily. Every one must have remarked that when a sudden change of weather from hot to cold occurs the kidneys act at once very freely. This is simply due to a rapid diminution, in consequence of the lowered temperature, of the insensible perspiration. The sweat is usually acid. Sometimes it becomes intensely so, as in rheumatic fever; on the other hand, when profuse it may be alkaline or neutral, and then it putrifies readily, giving rise to odours which are extremely unpleasant, both to the person and to those around him.

The second variety of secreting glands found in the skin are the oil glands. A modification of these are the glands which form the wax found in the ear passage. These oil glands, or sebaceous glands as they are called, are commonly placed in close association with hairs. Most of them indeed open into the sac, or follicle which produces the hair, and the fatty material which they provide is conveyed gradually to the surface by the hair in its process of growth. It thus oils the hair as well as the skin. Each gland consists of a number of pouches containing cells, which elaborate the oily material, and finally burst and set it free. Sometimes this oily matter is produced in too fluid a state, and when so, can be seen to ooze in minute drops from the oil glands of the nose and cheeks. Dust and smoke adhere easily to this, and the face constantly looks grimy and unwashed. There are no oil glands on the palms or fingers, but the sweat secreted there is greasy; and this explains why, when a hand moist with perspiration is placed on paper it leaves a stain. In some of the lower animals, the aquatic birds in particular, these oil glands are much more highly developed. In them they oil the feathers which otherwise would become wet and heavy; and hence the saying that "our words made no more impression than water on a duck's back." Sebum, as this oily matter is termed, tends when allowed

to accumulate, and in consequence of the heat of the body, to become rancid, and smell strongly. This is more apt to occur in the dark than the white races of mankind. It would appear that every one has an odour peculiar to himself, and it is this which enables the dog to recognise his master, the bloodhound to track the outlaw. When the hands are brought in contact with animal or vegetable matter in a state of decomposition, the smell of the substance touched attaches itself to them, and in all likelihood especially to the fatty secretion. Soap does not remove the odour. Carbolic acid or Condy's fluid disguises it for a time, to reappear nearly as pungently as ever. If, however, as Dr Foulis has suggested, we smear the hands well with turpentine which dissolves the oily secretion, and then wash them with soap, the unpleasant smell will be found to be permanently and harmlessly removed. This is not a mere matter of sentiment. Some poisonous materials can thus be conveyed from one person to another. By employing turpentine these are rendered innocent, and the danger of contagion lessened materially if not altogether abolished.

The third series of skin glands are those which produce the hair, and these exist nearly universally. On the palms and soles and one or two other situations they are absent. These glands are seated at various depths; those which form the fine down which covers the arms, back, &c., are near the surface, those whence the hair of the head and beard grow are planted deep among the fat cells under the skin. The hair glands are only foldings in or pouches of the skin; and the hair is nothing more than the horny covering of the skin, which has grown into a thread-like form. The pouch which produces the hair is wider below than above, and has a nipple-like projection at its deepest part, into which bloodvessels and nerves run. This is the active agent in forming the hair. The root of the hair has a dimple, much like the hollow in a champagne bottle, corresponding to the hair papilla, and is soft. As it grows upwards it becomes firmer, and when it emerges from the skin the hair consists of a bundle of fibres, variously coloured in different individuals, bound together by flat plates, the lower of which always slightly overlaps the next above. This overlapping serves several pur-

poses. One of these is that, as the hair grows, the projecting edges of these plates, scraping the sides of the tube surrounding the hair, carry before them any particles which have become detached from the inside of the pouch, and also the oil secreted by the oil gland which opens into it. Thus the hair literally sweeps out its own follicle. When the hair has become free on the surface, this arrangement permits us to brush dust, &c., from its root to its point, and also favours the conveyance of perspiration or water from the body. Hairs are set at an angle to the surface, not perpendicular, and in what are called whorls or spirals. This spiral arrangement of the hair is well seen on the crown of most boys' heads. Hairs are not in general quite round, but somewhat oval, and the greater the oval the more the hair tends to curl. Hair, too, is nearly indestructible by time alone. A coil of hair, with the pins of jet still sticking in it, once the ornament of a young Roman lady, was found the other day quite fresh in a stone coffin near York, carrying us back to the dawn of the Christian era.

During life, however, each hair has a definite period of life. This is much longer in some persons than in others, and bears some relation to the state of health. A calm, easy life, a placid disposition, and a well-nourished body, offer a combination of circumstances most favourable to the production of long hair. Such was in all likelihood the condition of that worthy burgomaster of Brock, a sleepy town in Holland, of whom it is recorded that he had so voluminous a beard that he kept it tied up in a bag. One day having permitted it to hang down unrestrained, he tripped over it on the stair of the Court-house, fell and broke his neck. The nutrition of the hair is often a good index of the state of health. Thus when it is glossy and pliant, does not fall off much, is weak or split easily, the possessor may, as a rule, be considered as in good health. In most persons, as age advances, it becomes white. This is rarely if ever unbecoming. It is said that a lady once remarked to Douglas Jerrold that she could not understand why her hair was turning grey, unless it was occasioned by the essence of rosemary which her maid was in the habit of using to wash her head with. "I fear," said the

witty dramatist, "it is much more likely to be due to the essence of time." Some, however, apparently forgetful that there is something incongruous between a wrinkled cheek and dark hair, try to improve on nature by using artificial dyes. Though most of these contain lead, probably any harm they can do is exaggerated, yet they are rarely successful because too much is attempted, and the fraud becomes patent to all. Each season in the year of life has its peculiar and suitable tints, which blend to form a consistent and beautiful whole.

The nails are plates of horny material which correspond to the outer layer of the cuticle. They, like the hairs, grow from a root, the imbedded part of the nail farthest from the point of the finger. They are, however, firmly attached to the bed or quick, over which in growing they slide, receiving little, if any, increase of thickness from it. The object of the nails seems to be to make the point of the finger firmer than it would be did it end round and pulpy. Nails grow more quickly in the young than the old, in summer than in winter; and the rate of growth of the nails on corresponding fingers of each hand is not quite uniform. It averages $\frac{1}{30}$ of an inch a week on the hand, less on the feet. During severe illness, such as rheumatic fever, the growth of the nail at its root is arrested, and when recovery has taken place and the nail increases again, a groove appears by-and-bye on its surface, which in depth and breadth bears relation to the length of time the illness has lasted. This may serve to show what a shock such illnesses give to the system generally.

Dried up and decayed cuticle often accumulates by the side of the great toe nail, more particularly on the side next the other toes. This being picked out with the scissors, when the nails are cut, the pressure of the boot, too frequently made very narrow at the toe, forces the edge of the nail against the tender part from which the accumulation has been removed. The pressure leads to the formation of a sore; proud flesh sprouts out, and the nail is said to have "grown in," necessitating sometimes a painful operation for its cure. All this might be avoided were boots or shoes with broad square toes worn, the toe nails simply cut straight across, and the sides cleaned by means of a nail brush,

soap, and warm water, and never picked. When dirt gathers under the free edge of the finger nails it should not be scooped out with a pen-knife, but washed away with soap and water and a brush. Picking the nail raises it unnaturally from its bed, and more dirt collects. It should be remembered, too, that children's feet grow fast, at an early age especially, and shoes soon become too short—the great toe, prevented from becoming longer, bends towards the second toe, the foot is weakened, and in time bunions form on the ball of the great toe. It is rare to find an absolutely natural great toe, just because at some time too short shoes have been worn when the foot was growing.

Having placed before you this sketch of the structures which compose the skin and its appendages, its management in health must now engage our attention. Cleanliness is in great measure the outcome of a state of civilization. Among savages when in their wild condition washing is almost unknown. The human being in a state of nature uses water simply to cool his body in summer, never to cleanse it. In winter he wears unchanged the skins or mats which form his defence from the cold. The higher the state of civilization the more the luxury of bathing is indulged in. Yet there are many thousands in this country who never wash from year's end to year's end. Two Glasgow lads were disporting themselves in the Gareloch one warm day during the fair holidays. One remarked to the other how black his skin was. "And so would yours be," was the reply, "if you had not touched water since this time last year." History repeats itself, and just as bathing was an art among the ancient Greeks and Romans, so the multiplication of water cure or hydropathic establishments among ourselves must be looked on as an evidence of the estimation in which baths are held by the middle classes now.

No sooner have we opened our eyes and uttered our first shrill cry as helpless infants, than our nurse sets to with a will and soaps and scrubs us till our skin glows rosy pink. For six months, perhaps longer, be our home the poorest, we have a daily bath at least. As we begin to move about, and come more directly in contact with dirt, by a strange inconsistency we are

less often washed; and by the end of our second year we may, if mother is also nurse, and a successor to the honours of the bath has appeared, be put off with a weekly Saturday night's tubbing. When a little older the boy or girl in many a poor home is well off if he even gets that. I know there are many difficulties in the way, when rooms are small and furniture scanty. But a great deal might be done by hanging a sheet across a corner of the room, behind which a thorough wash might with due regard to propriety be obtained.

What happens when the skin is not regularly washed and kept clean? The dust which is always around us, the particles thrown off by our clothes in course of wear, and the secretions which are perpetually being poured out by the glands of the skin themselves, all accumulating, plug up the innumerable openings, and prevent their working. Hence an indispensable agent in getting rid of much worn out material from the system acts but very imperfectly, and more work is thrown on internal organs to take its place. Health suffers, and though the body with wonderful adaptability to circumstances submits to much, still discomfort, to say the least, to the individual arises, and annoyance to the more cleanly members of society. Singular to say, our paupers dislike extremely the bath which is the necessary introduction to the workhouse, and many members of the lawless classes detest the prison regulations as to washing. Hence that cleanliness so scrupulously observed by many of the lower animals seems to be an acquired habit in man.

The skin from being oily cannot be cleaned by water alone. And though the morning cold bath is bracing and invigorating, and aided and supplemented by friction with a rough towel, removes much of this secretion, some substance which will so alter the greasy coating as to render it capable of being washed off must be employed in addition. This is found in soap. Now soap consists of a combination of an alkali, such as soda or potash, and oil or fat. These when mixed and boiled in certain proportions form a definite compound, either hard when soda, or soft when potash is the alkali. There is always in soap some free or uncombined alkali, and this, when the soap is rubbed with

water on the body, unites with and renders soluble the oily material of the skin. Potash soaps contain too much and too strong an alkali, hence when the skin is washed with soft or black soap, the natural oil is so thoroughly removed, that the skin is left dry and harsh, and feels to its owner as if too tight for him. The injurious effects of the constant use of these strong soaps are seen on the hands of washer-women, in whom they produce a disease which cannot be cured unless the employment is abandoned. In a well-made soap, however, a soda or hard soap, compounded from pure fat, thoroughly boiled, and then matured by keeping—all good housekeepers know the economy there is in having soap for some time in the house before it is used—the amount of free alkali is small. This cleanses the skin, but not entirely removing the oil, leaves it soft and pliant. All soap should be entirely washed off with water before the skin is dried. Unless this is done the face looks shiny and smooth, more suggestive of an attempted than a completed washing. "Use doth beget a habit in a man," thus the more regularly and constantly soap is employed the more it becomes a necessity of life. Those who wash daily with soap miss it more when from illness or any other cause they are deprived of it, than those to whom its use is merely occasional.

A word must be said about various kinds of soaps. Old Castile soap or Pears' soap are excellent, but expensive. Very pure soap can scarcely be cheap. The fatty ingredients must be selected and pure; and the soap like good wine should not be too new before it is sold. All this costs money, and must be paid for. Pears' soap and transparent soap generally is further purified by being dissolved in spirit, which removes any accidental impurities. White soap made by respectable firms is usually pure enough for all ordinary purposes. Highly coloured and scented soaps, too often reserved specially for baby's use, are in general to be avoided, and so are medicated soaps. Sulphur soaps, for instance, are irritating, and so are carbolic acid soaps. The latter is sometimes useful as a disinfectant, but when kept, the carbolic acid evaporates, and with it any particular virtue. Coal tar soap is of a little value in some diseases of the skin, in

most it does harm. One soap I can recommend, as it is made at present—Sanitas toilet soap. Sanitas is turpentine, through which a stream of hot air has been passed for a long time. The turpentine becomes chemically altered in the process, and this, when combined with a well-made soap, imparts to it an agreeable odour, and makes it more cleansing, though not too drying for the skin. A little of this soap goes a long way. The hair when washed with it feels free and clean on being combed. Sanitas fluid itself, diluted with four times as much water, makes a good wash for the hair. Honey soap is said to be a good soap. Glycerine soap is not, for the glycerine does not unite with the soap, and exudes as drops on its surface.

There are popular prejudices against washing certain parts of the body. One of these is that the face should not be washed with soap, as thereby the complexion would be injured. Now the reverse is really the fact. Dust and soot adhere to the oily material poured out by the glands of the face, and stop up their openings. Unless soap is used to keep them free and active, these glands become sluggish, and thus give rise to a "bad complexion." No doubt in many cases there are other causes at work, as indigestion, tight-lacing, living in close ill-lighted rooms—sunlight being as necessary to produce bright and fresh colour in human beings as it is in plants. Unhealthy occupations are also causes, and occupations which not in themselves unhealthy are made so unnecessarily. Thus many shop-girls are seriously injured, because their employers insist on their standing behind a counter for many hours without sitting down, even when not employed in attending on customers. I mention this particularly since attention has lately been drawn to this species of cruelty by the medical papers. The plan is a short-sighted one, for tired girls cannot so well or so cheerfully work as those refreshed by resting from time to time, when not actively engaged in selling. This is a real cause of not a few of the pale and spotted faces we see among shop-girls.

Again, colliers, perhaps other operatives, believe that washing the back weakens it, and thus leave it untouched. There is a

trace of human inconsistency here, since their wives bathe their children's weak legs to strengthen them.

The feet though in constant use do not receive their due share of washing, though they need it as much or more than other parts which always in view are necessarily cleansed frequently.

Mothers and nurses refrain, possibly through a mistaken fear of giving cold, from washing that part of infants' heads on the top in front where the bone is defective at birth, popularly known as the "open of the head." Hence a greasy substance gathers, forms a thin crust, this turns rancid, and becomes often a starting point of those outstrikings on the face and head of infants which are ascribed to teething. This part of the child should be washed as often and as carefully as any other, dried scrupulously, and, if necessary, anointed with a little vaseline or cold cream to prevent scurf from collecting.

If at all possible, the whole body should be washed once a day. The best time is on rising in the morning, as then the plunge into water, which should be, at all seasons, about the temperature of 60°, is invigorating and refreshing after awakening from sleep. A very few minutes suffices, and the hardening effect on the body, rendering it less liable to be afterwards chilled during exposure to this variable climate of ours, is worth all the time snatched from sleep. A substitute for the plunge into water may be extemporized by dipping a towel in cold water, and thoroughly scrubbing the body with it. Such a bath causes the muscles of the skin to contract, lessens the amount of perspiration for a time, and acts as a tonic.

A bath should not be taken immediately or even soon after a meal. An hour and a-half at least should be allowed to elapse. This applies to all forms of baths. A cold one first drives the blood from the surface and blanches the skin, followed, if the exposure be not too prolonged, by an agreeable sensation of warmth, and a feeling of lightness and increased vigour. This is due to the bloodvessels again dilating and the warm current flowing through them with augmented activity. It is this pleasant afterglow which is the test of the beneficial effect of a bath or otherwise.

Unless it is experienced in some degree a cold bath should not be indulged in.

When the blanching of the skin, due to the sudden contact of cold water with its surface, takes place, the blood displaced from the skin congests internal organs, and this occurring when digestion is actively going on interferes with its progress, and disturbs its regular course. This also explains why persons sometimes feel sick after a bath, and why we pant when we step first into the sea, at least when the water reaches the level of the chest, the lungs being for a time overfilled with blood. A warm bath on the contrary raises the temperature of the skin above its natural standard, and withdraws blood rapidly from internal organs, as the stomach or brain. Faintness may thus be induced in those who have naturally little blood, or are otherwise not very strong. The brain in them, not at any time over well supplied with blood, becomes still less so, and faintness or actual fainting occurs. When we come out of the warm water and the skin is dried, the cooler air around us increases evaporation from the skin, and also drives the artificial excess of blood away from it, and we feel cold. Thus the warm bath has its uses, and there are times also when it cannot be employed without harm. It may be used beneficially to cool a fevered skin, and so it is constantly made use of in many children's diseases. Or, again, to restore the proper action of the skin, when this has been checked by exposure to cold or damp. When this has been done, however, the artificially induced warmth must be maintained by going to bed. Thus a warm bath pure and simple, and by this I mean one whose temperature is above 95°, should only be taken when this is possible immediately after. As thermometers are not always at hand, a ready way of estimating the heat of the bath is to plunge the naked elbow into the water, and thus we can very accurately determine it. There will thus be no risk of scalding children, as has been done, when the hand which often stands a high temperature is used as the test. A warm bath interferes with digestion by withdrawing blood from the stomach, and thus checking the process.

We can by certain medicines stimulate the sweat glands to increased activity, but as a means of perfectly and thoroughly

cleansing the skin the Turkish bath stands unequalled. In it we have, first, profuse perspiration, due to continued exposure to a high temperature, then thorough cleansing by means of soap, and, finally, a gradual cooling down by a spray bath, whose heat is constantly diminished to nearly icy coldness. It must be borne in mind, however, that the Turkish bath does not agree with every one, nor is it to be employed except occasionally, for though producing at the time a sense of increased strength and buoyancy, its too frequent repetition is not without risk, and to it has been ascribed with some reason the origin of one form at least of skin disease. A remarkable instance of the effect of the Turkish bath on the skin was given by an Irishman, who, writing home to his friends, after describing how the bathman, during the shampooing process, scraped off layer after layer of accumulated dirt, declared that he finally triumphantly unearthed an old flannel under vest, of whose existence the said Irishman had had no recollection.

It may be well to say a word here as to bathing in fresh and salt water, and their influence on the skin. Sea bathing is admitted by all to be much more invigorating than fresh water. Much of this is due to the pure sea air, and to the rest from care and business which accompanies a residence at the seaside. But there must be a something in the water itself, and this has usually been explained as dependant on its higher specific gravity. Further than this we cannot at present safely go; certain it is that a sea bath is more strengthening, and if from the presence of salt less cleansing, can be indulged in by those who would derive little advantage from a river or lake bath, though in the absence of sea water these are not to be despised.

Is it safe to bathe when warm and freely perspiring? Yes, if from previous experience we are conscious of that pleasant glow on emerging from the water of which I have already spoken, and provided we are still vigorous and healthy. While the blood flows rapidly through the vessels, and the skin is turgid, a plunge into moderately cold water taken at once, and followed by friction in drying and then hasty dressing, is safe and advantageous. Should, however, the perspiration have ceased and dried, and the skin again become relaxed, a cold bath cannot be indulged in

without risk. There is no subsequent glow and reaction, nausea is apt to supervene, and ill effects to the system generally to follow. Even a tepid or warm bath should then be taken with care.

Hard water is injurious to the skin. It makes it rough, and tend to chap, all the more if easterly winds are prevalent. Hardness in water chiefly depends on the presence of a compound of lime, commonly the carbonate. This, when brought in contact with soap, decomposes it. The lime unites with the oily acid, and forms with it a soap of lime, which is insoluble. The potash or soda thus set free unites too perfectly with the natural oil of the skin, and thus dries it. Boiling renders hard water somewhat less so. The carbonate of lime is held in solution in the water by free or uncombined carbonic acid. Boiling drives this off, and so much of the lime is deposited. This composes most of the crust which forms in our kettles and boilers. When only hard water is available, we can thus make it softer and less injurious to the skin. Rain or river water is preferable, if these can be had.

When persons grow old they not unfrequently become less careful about washing themselves. No doubt with failing health less regard for personal appearance, and possibly a degree of laziness, there is an explanation, but not always an excuse for this. But as the skin becomes more shrunken its glands are less active, and dirt and its own excretions accumulate in the wrinkles and furrows, consequently washing should be more carefully done, but with warm water.

The care of the skin, however, does not merely consist in washing it. Its due covering and protection are as necessary, perhaps even more so. There is quite an agreement among medical men that in our cold, damp, and too often sunless climate, nothing surpasses flannel or some woollen material as the article of clothing to be worn next the skin. Wool is a bad conductor of heat, and thus keeps in and maintains the warmth of the body. It absorbs the perspiration and oil, and takes up the dry scales which are being constantly thrown off. Thus it should be changed pretty often. Just about a hundred years ago Hugo Arnot gave

as an instance of remarkable personal cleanliness, that the late Archbishop of Glasgow put on a clean shirt once a week! Though this would not excite wonder at the present day, the fear of changing body linen still lingers in the case of sick persons and children, whose comfort is interfered with and whose illnesses are sometimes prolonged through a false dread of their catching cold were this done. Provided that those to be put on are warm and dry, there are few instances indeed where a frequent change is not in every respect beneficial, care being taken that in the process the sick person is not unduly fatigued. In the case of children warm under flannels are very necessary, as they bear cold badly, and the younger the child the less resistant it is to it. Fashion still rules the day as regards the outer garments, but those next the skin should be warm and close-fitting. The same underclothes should never be worn at night as well as in the day; and, except in children, where flannel suits best, cotton or linen should be the material of the night-dress.

A whole lecture might be devoted to the hair, and yet its management in health need not detain us long. When short the hair may be washed, if desired, every day, and this practice, if commenced in early life, and continued, is said to postpone at least its becoming grey. It should be washed as often as necessary to keep it clean and its roots healthy. Any good soap may be used to wash it with, or the white of an egg well whipped up, which cleanses it without drying it so much as soap does. It is often recommended to wash the hair with borax. This cleans it, but leaves it dry, therefore very little should be used; and after the hair has dried some simple oil or pomade ought to be applied, to take the place of the natural oil which has been dissolved away. An oft quoted dictum of some one notwithstanding that "one cannot brush the head too much or the hair too little," brushing should be gentle, and a brush with bristles which are neither too stiff nor too closely set should be chosen. A hard brush breaks and bruises the hair, although it seems to be doing good by scraping off a cloud of scurf. One is apt to forget that the scurf re-forms faster than ever when thus roughly

scratched away. Use, then, a soft brush, and use it gently. And wash the head once a week or fortnight, if not habitually daily. The teeth of the comb should not have sharp points, as these tear the skin of the head. *A small tooth comb should never be used.* It does more harm than a hard brush when employed to get rid of dandriff or scurf, and for any other purpose there are better and more certain methods. A little pomade does no harm, provided it is simple. Perhaps the best is made of equal parts of pure cold cream and vaseline, or cocoa-not oil and vaseline.

At present the natural style of dressing the hair of females may be said to be in vogue. Long may it continue so. And may we never see the return of pads or chignons or other artificial appendages or supports. No part of the body, ladies' waists and perhaps feet excepted, has been so much tortured by fashion, and baldness becomes every day more frequent in both sexes. In women dragging the hair over huge chignons, which themselves over-heated the head, caused it to fall off; and in men the style of head-covering usually worn is blameable for much. Blue coat boys, and the waifs and strays of our lanes, who mostly go bare-headed, have thick heads of hair and retain it long. The same may be said of peasants abroad, who work all day with heads uncovered, or with merely a handkerchief rolled round the head to protect it from the sun. The heads of hair of savage races are quite marvellous for their thickness. Those, on the contrary, who wear hats, especially hard or close-fitting felt or silk hats, lose it soon. No doubt there are other causes—hereditary predisposition, want or thinness of blood, anxiety and worry, still these are secondary. The hat confines the perspiration which rots the hair, and makes it scurfy and dry, while the hard rim of the leather lining band presses the bloodvessels of the temple against the skull, and thus starves the hair by diminishing its supply of nutriment. Hats, then, should first be soft and easy; and second, should be so ventilated that a current of air passes freely over the head. For this purpose it is not enough to have a few holes punched in the crown. The lining band should be made of soft material, widely separated from the hat by a space, and holes made in the sides and front of the hat

itself. This allows free ingress and agress of air, and were this plan adopted and made use of in all head coverings, we would have fewer colds in the head and fewer bald men. The tall or chimney-pot hat worn as dress in this country is too heavy as a rule. In fact it is not a suitable covering for the head in a climate like ours, where rain and particularly high winds prevail. In France and Italy the hats made and worn are much lighter than ours, which are necessarily stronger and heavier to resist the wind. Hence a more rational hat would be a lower and softer one. And when we become wise enough to dress according to the dictates of reason and not fashion, such a hat will be universal; as it is, some clergymen alone adopt it in town.

One reason why women are less often bald than men is undoubtedly because their heads are less closely covered.

Cutting the hair frequently causes it to grow thicker, at least if the hair be moderately short. When the ends of long hair tend to split, the hair should be trimmed at its points, each hair being cut a short way above where it has split, and a little oil applied to the ends. There is no virtue whatever in singeing the hair.

In conclusion, it will be evident that scrupulous cleanliness and suitable protection from cold and variations of temperature are the means requisite to maintain the skin (and with it the body generally, so far as the influence of the skin is concerned) in activity and health.

HOW WE DIGEST OUR FOOD.

By JAMES FOULIS, M.D., F.R.C.P.

Man stands at the head of the animal world and has all things in subjection under him, yet he comes from an extremely minute germ or egg, not more than the $\frac{1}{200}$th part of an inch in diameter, and weighing scarcely the $\frac{1}{1000}$th of a grain. An adult man weighs about 130 pounds, so that he weighs a thousand million times more than the germ from which he started.

This little egg or germ, if placed in suitable conditions, has within it the power of absorbing or imbibing nourishment. It has no lungs, no stomach, no heart or any trace of an organ of digestion; and yet it will grow and develope into a perfect human being, if the conditions favourable to such development are present. The first trace of the development consists in the division of the little egg into two halves. It actually divides itself into two halves—then each half divides itself, and then each quarter divides itself, and this division goes on until the whole egg is reduced to an immense number of little bodies called *cells*. Each of these little cells, though much smaller than the original egg, is very like it in structure. The mass of cells thus produced continue to absorb nourishment from the mother's blood, just as the egg did in the first instance. Presently the cells arrange themselves in a peculiar manner, some of them develope into the brain and spinal marrow, others develope into heart and lungs, others into bone, and so on until the perfect little human being is formed. Now, what I have told you of the first steps in the development of man, is exactly the same as takes place in the first steps of the development of every vertebrate animal. In the cat, the

dog, the monkey, the elephant, and all the other animals of this class, a minute egg is the first trace of the animal. Division and subdivision of the egg takes place, and then the minute bodies or cells formed by this process of division gradually give rise to the different organs and the distinguishing characteristics of each animal.

I mention these few facts about the first steps in the development of man, because I wish to direct your attention to the wonderful power possessed by the small bodies which we term "*cells.*" I shall have to show you that in the human body there are millions upon millions of minute cells, all undoubtedly derived from the original germ or egg, and that these cells are really the means by which we digest our food. I shall have to show you that although we eat food, we, as individuals, do not digest it. We cannot digest our food, let us try ever so hard. We do not digest our food by any effort of our wills. We cannot convert our food into flesh and blood any more than we can control the beating of our hearts. The digestion of food, or the process of converting it into soluble material so that it may pass into the blood, is entirely carried out by the agency of countless millions of cells lining the alimentary canal, over which we have no direct control whatever. I hope to make this clear to you by-and-by.

Before the child is born, although it possesses a stomach and intestines, a mouth, and other organs of digestion, it does not *eat* food. Such nourishment as it requires is absorbed from the mother's blood. The mother eats the food and digests it, while the child absorbs such nourishment as is necessary for its development. This absorption of nourishment by the child takes place without either the mother or child knowing anything about it!

When the time has arrived for the young child to lead a separate existence, it comes into the world the most helpless of all animals. Before its birth no air entered its lungs; but now on coming into the world it opens its mouth and begins to cry lustily. By this means it breathes the breath of life; but with this breath of life it also breathes in a tendency to death, for if it breathes the oxygen of the air it begins to waste or burn away, and if not fed with milk or other appropriate food it will surely

die. Let it have food, and the minute cells which constitute the essential parts of the organs of digestion will convert this food into flesh and blood, and the young creature will grow faster than it can waste away; and thus it will pass from childhood to boyhood, and from boyhood to manhood.

When fully grown a man has more than 200 bones in his skeleton. In the skull we see the cavity which contains the brain —the organ of mind. The eyes, the ears, the nose, the mouth, are situated in close relation to the brain. In the vertebral column is a tube which contains the spinal marrow, and attached to the spinal column are the ribs, which enclose the chest cavity, in which are placed the heart and lungs. Then we see the different bones which form the arms and legs and hands. All these parts are clothed with muscles.

There are more than 400 muscles in the human body. The muscles, by contracting, move the limbs. It is by means of the muscles that we can walk about and move our bodies from one place to another. There is a very remarkable muscle called the *diaphragm* or *midriff*, which runs across from the bottom of the ribs to the spine, shutting off the cavity of the chest from the abdominal cavity. In the cavity of the abdomen are placed the organs of digestion, the *stomach*, *liver*, *intestines*, and *pancreas*. In the chest the heart and lungs rest on the upper surface of the muscle called the diaphragm.

The whole body is clothed with the skin or integument. This skin can be easily removed from all parts, but at the margins of the various apertures of the body it seems to stop, and becomes continuous with the mucous membrane which lines all those internal cavities, such as the alimentary canal, into which the apertures open. Every well nourished body has a considerable quantity of fat between the skin and the muscles, and it is this fat which gives such beauty and roundness of form to the human body. Sometimes the fat is of enormous thickness. In very stout people fat under the skin is sometimes several inches in thickness. It is often deposited in a very thick layer under the skin over the abdomen. In this situation I have seen it seven inches thick. In the skin over the surface of the body there are numerous sweat

glands. These glands are minute tubes, and are about two and a half millions in number, and to show you how important they are as organs of perspiration, I may tell you that if these little tubes were placed end to end, they would form one tube 28 miles in length. While you judge of the beauty of the human body when properly nourished, as depicted in the statue of the Three Graces, as a contrast you may look on the horrible effects of starvation. In the famine at Orissa, in India, several years ago, many thousands of our fellow-creatures were starved to death.

What I now show you is a photograph, from life, of some of the poor starved creatures. Only those who have witnessed death from starvation know of its horrors. Let us who have a good supply of food, although from other nations, think twice before we venture to tax the food supply of this country.

Now the body of a living man is always in a state of activity. Even when he is asleep, although the head and limbs are quiet, the heaving chest shows that some parts are active. At all times, day and night, the heart is beating, driving the hot blood to all parts of the body to nourish the various tissues, and to take up the effete and used up material which are conveyed to the lungs, skin, and kidneys, to be thrown off from the body as excretions.

All work means waste. No fire can burn without the coal being consumed, and ashes remain.

Suppose we have a room with walls of ice. As long as the air in the room is *ice* cold, the walls of the chamber will not melt. Let us carefully weigh a healthy living man, and then make him walk up and down in the room for an hour. In doing this he will clearly exert a good deal of mechanical force. At the end of an hour we shall observe that a certain amount of ice has been melted, showing that the man has given off heat in abundance. And if we now examine the air of the room, we shall find that it contains moisture which has been breathed out by the man, and has been given off from his skin by perspiration. If at the end of an hour we again carefully weigh the man we shall find that he has lost weight. Now, from all this, we learn that a living active man constantly exerts mechanical force, gives off heat,

evolves carbonic acid and water from his lungs and skin, and undergoes loss of weight.

Now it is quite clear that this sort of thing could not go on for long without the man wasting away to nothing.

Long before this takes place, however, the man feels hunger and thirst, a craving for food and drink and fresh air with which to build up and to restore the body to its former weight.

For this purpose man takes into his mouth, and then passes into his alimentary canal, every day a certain quantity of food in the form of meat, bread, butter, water, and the like. It is important that you should ever bear in mind that the substances used as food come under four heads:

1*st.* The nitrogenous food, such as the gluten of wheat, the albumen of white of egg, the fibrine of blood, the syntonin of muscle, the casein of cheese.

2*d*, Fatty Foods, such as all vegetable and animal oils,—as, butter, bacon, and oils, &c.

3*d*, Starchy Foods, such as starch and sugar, and nearly all the farinaceous foods, such as arrowroot, corn-flour, potatoes, come under this head.

4*th*, Mineral matters,—under which head are water and the salts of various metals.

Food, then, in the form of nitrogenous, fatty, starchy, and mineral material, separately or altogether, are introduced into the alimentary canal. *The whole purpose of digestion is to reduce these foods into a condition either of solution or extremely fine division, in order that they may readily pass into the blood through the thin membranes which form the walls of the capillary blood-vessels in the mucous membrane of the alimentary canal.*

The Teeth.

In the mouth the food is subjected to two different operations, viz., Mastication and Insalivation. By mastication, or chewing, the food is cut up and ground down by the teeth to a state of minute division. This is entirely a mechanical process. It is necessary, in order that the food may be properly acted on by

the different digestive fluids. The teeth are very important organs of digestion. There are marked differences in the teeth, both as to structure and action, corresponding to the habits of the animal and the food it eats.

In fishes and serpents the teeth are generally in the form of spines curved backwards; they serve to catch and hold their prey, and to prevent its escape. In such animals the food is swallowed whole or in large masses, and the digestion is very slow.

In animals which eat flesh, such as the lion, tiger, cat, and dog, there are three different kinds of teeth. The cutting teeth, or incisors, are six in each jaw; these cut the food like a pair of scissors. Next to these are long teeth, in the form of tusks; they are pointed and conical. They enable the animal to get a good hold of its prey, and they pierce the flesh through and through. Then come the molars, or grinders, eight or more in number on each side; they are large and broad teeth, with sharp edges, which have several points or cusps, like the teeth of a saw. In flesh-eating animals the chewing process is very imperfect. The flesh is not ground down, but is only pierced through and through, and mangled before it passes into the stomach.

In animals which live on vegetable food, such as grass, the cutting teeth, or incisors, are only in the lower jaw in those animals which "chew the cud;" but in the horse they are found in both upper and lower jaws. In these animals the incisors simply nip off the blades of grass. The chewing is performed by the grinders. The grinders are large and flat, and their surfaces have projecting ridges of hard material, called *enamel*. By the lateral rubbing motion of these rough surfaces together the food is reduced to a soft pulpy mass.

In the human being the teeth present the characters of the teeth of the flesh-eating and of the vegetable-eating animal.

The incisors are four in number in each jaw. The canines are much less prominent and pointed than in flesh-eating animals. The molars, or grinders, are thick and strong, and have on their surfaces little points or cusps, like we see in the teeth of flesh-eating animals. There can be little doubt, from the structure of the teeth alone, that man is both a flesh and a vegetable eating

animal. Man chews his vegetable food just as perfectly as do the grass-eating animals, and he chews his meat much more perfectly than do the flesh-eating animals.

The teeth perform a most important part of the digestive process. If the food is not properly chewed or masticated, and is swallowed in masses or undivided lumps, it will remain in the stomach a long time undissolved and prove to be a source of irritation to the delicate mucous membrane of the stomach, but if it is properly chewed, and reduced to a state of pulp before it is swallowed, it is then readily attacked by the gastric juice and other fluids, and is rapidly dissolved; hence the great importance of thoroughly chewing food before it is swallowed.

In the human being, each little tooth consists of a crown, a neck, and fangs. The crown is that part which projects above the gums, and is covered with a layer of enamel—the hardest substance in the body. Beneath the enamel is the dentine, a substance like ivory. In the centre of the dentine is a cavity termed the *pulp cavity*, which contains the tooth pulp, a very sensitive body, consisting of bloodvessels and nerves which enter the tooth through a small opening at the end of the fang. Where the teeth rub against each other the enamel and the dentine wear away; but the dentine being much softer than the enamel, wears away more quickly. In the front teeth of animals such as the beaver, the rat, the hare, and the rabbit, the edges are very sharp. The sharp edge consists of enamel, which has not worn away so quickly as the dentine.

In the human being teeth are objects ot great beauty when free from decay and properly arranged. Decayed teeth injuriously affect the health in two ways. When broken down they do not grind the food properly, and when decayed they make the breath offensive, because there is always an offensive odour around a decayed tooth. If the teeth are not cleaned day and night, little particles of food get in between the teeth, near the gums, and irritate the latter, which become inflamed, and a white cheesey looking material is apt to accumulate on the edge of the gums. If a very small speck of this white cheesey material is mixed up with some spittle and examined under high powers of the

microscope, it is found to consist chiefly of a sort of fungus, and in among the branches of the fungus are myriads of minute, rapidly moving animalcules called *vibrios* and *bacteria*. It is an extraordinary sight, and once a person has seen it I think he will ot neglect to clean his teeth day and night. The teeth may be well cleaned by brushing them with soap and water morning and night. After cleaning the teeth in this way, the mouth may be made sweet by washing it out with a teaspoonful of Condy's fluid, dissolved in a tumbler of warm water.

The Saliva.

As the food is being chewed, it is at the same time mixed with the *saliva* or spittle. This saliva is the first of the digestive fluids.

The mucous membrane of the mouth is dotted over with minute tubules, called "buccal glands." These tubes are lined with extremely minute cells. The spittle or saliva is not a simple fluid. It consists of four distinct fluids. The buccal glands pour out a quantity of mucous, which mixes with the secretions which come from the *parotid*, *submaxillary*, and *sublingual* glands. The latter glands exist in pairs. Each parotid gland lies in front of the ear, and behind the angle of the jaw; and its duct opens into the mouth opposite the second grinder tooth of the upper jaw. The submaxillary glands and sublingual glands are placed in the floor of the mouth, and they pour their secretions into the mouth through two little openings which lie under the tip of the tongue, behind the front teeth of the lower jaw. These three glands swell up to a great size when a child has the mumps.

The saliva is a thin watery fluid, and contains in solution a small quantity of a remarkable substance called *ptyalin*, which possesses remarkable properties.

It does not affect in the least nitrogenous food or fats; but if mixed with starch and kept at a warm temperature, the saliva in time will convert starch into grape sugar. Starch is quite insoluble and useless as nourishment, but when acted on by

saliva it becomes a highly soluble and nutritious form of sugar called grape sugar. How is this saliva manufactured? It is poured out to the extent of about 1½ lbs. in twenty-four hours.

The parotid and submaxillary glands and sublingual glands are good examples of what are called *racemose* glands. They are in general form like a small bunch of grapes. The main stalk represents the duct by which the secretion enters the mouth. The parotid gland consists of a great number of little sacs or bags, and each little bag is lined with a layer of extremely minute cells. Each little bag has on the outside of it an immense number of little bloodvessels. When the parotid gland is secreting its fluid, the little cells lining the bags or sacs imbibe from the blood circulating around them such material as they require, and they manufacture it into saliva. We cannot make them do this, nor can we prevent them forming saliva by any effort of our will. The mere presence of food in the mouth causes these little cells to begin their work. The smell of a delicious dish is sometimes sufficient to make them pour out their secretions, and then the mouth "waters," as we express it. The saliva formed in each little bag is poured out into the main duct or channel, and through this into the mouth. Thus during the chewing of food, spittle is being poured into the mouth by the buccal glands, by the parotid, submaxillary, and sublingual glands. When first poured out this saliva is alkaline. Besides acting on the starchy elements of food and converting them into soluble sugar, the saliva keeps the mouth constantly moist. It also dissolves sugar and salt, which form part of our food; and it also makes the chewed food slippery and easily swallowed.

It is important that you should know that these salivary glands are not active in the child until the age of four or six months. Hence to give a child of such an age much starchy food, such as arrowroot or corn flour, means to poison it. I have frequently seen children at this tender age suffering from diarrhœa and other troubles of the digestive system brought about by starchy food, which the poor child was quite unable to digest.

When the food is thoroughly chewed and mixed with saliva it

is carried backwards by a semi-involuntary movement of the tongue, which at the same time presses down the epiglottis over the entrance into the windpipe, and the bolus of food is pushed into the commencement of the *œsophagus* or gullet, where, by the muscular action of the coats of the tube, it is carried down into the stomach.

Drink is taken in the same way. We must not suppose that the bolus of food and the gulps of water simply drop down from the back of the mouth into the stomach. This is not the case. Each mouthful is pushed backwards by the tongue, and then it is grasped by the muscular coats of the gullet and pushed down into the stomach. It is by means of this muscular action of the gullet that jugglers are able to eat and swallow food and drink while standing on their heads, and by this means the ox or the horse is able to drink water while its head is lower than its stomach.

The Gullet.

The gullet or œsophagus is a tube about nine or ten inches in length. Above it is continuous with the *pharynx*, whose mucous membrane is continuous with that lining the back of the mouth. The gullet passes down immediately behind the windpipe, through the chest, and then passing through the diaphragm it at once becomes connected with the stomach near its large dilated cardiac end. I remember, when I was a boy, being told that a whale could not swallow a man, because its swallow or gullet was so small. It was supposed, because the whale fed upon small fish and extremely minute creatures in the sea, that therefore it must have a small gullet. It fell to my lot some years ago to dissect the large whale which, you may remember, was thrown on the shore at Longniddry and then towed across to Kirkcaldy, and I made a point of ascertaining the exact size of the gullet. Now, without giving you the exact figures, I may tell you that a man could pass down the whale's gullet just as easily as he could slip down the barrel of one of Sir William Armstrong's 100-ton guns! If the whale which was said to have swallowed Jonah was anything like the whale which I cut up, all I can say is Jonah must

have had a very uncomfortable time of it, for in our whale's stomach there was about two tons weight of herrings and cod-fish, mixed up with no end of fish bones and several gallons of rancid oil. It is right, however, to say we are not told it was a whale that swallowed Jonah, but "a great fish." A whale is not a *fish* at all, but belongs to the class of animals to which man belongs. It is a mammal, and gives suck to its young one. No fish does that.

Every organ of digestion within the abdomen is invested by the *peritoneum*, a delicate membrane which lines the whole cavity of the abdomen, and then passes over every organ, giving a covering to each, and serving to bind them in their places.

The Stomach.

The stomach may be described as a large dilated tube, very like the bag of a bagpipe. One end of this dilated tube is much more blown out than the other end. This widely dilated part of the stomach is called the *cardiac* end, because it lies up against the under surface of the diaphragm, just under the heart. When the end of the stomach is full of wind the heart is often pressed upwards by it, and beats more powerfully against the chest wall, making a person believe he has some serious affection of the heart. The right end of the stomach gradually tapers off, and becomes continuous with the small intestine. Just before the stomach joins the intestine there is a valve, known as the *pyloric* valve, and the portion of the stomach near it is called the pyloric end of the stomach. The first part of the intestine in connection with the stomach is called the *duodenum.*

When the stomach is well filled it measures little more than twelve inches in length, and its greatest diameter is about five inches. If cut open and spread out like a handkerchief it would cover a space 1¼ feet square. The stomach does not lie straight across the upper part of the abdominal cavity. The bulged out cardiac end lies close against the under surface of the diaphragm on the left side, but the pyloric end of the stomach is situated much lower down on the right side, just below the margin

of the ribs. From the lower border of the stomach there hangs down a beautiful membrane, known as the *omentum*, which serves as a protection to the coils of intestine which are beneath it.

Underneath the peritoneal coat of the stomach there are two muscular coats—an external and an internal muscular coat. The fibres of the external muscular coat run along from the cardiac end to the pyloric end of the stomach, while the internal muscular fibres wind round the stomach something like the hoops round a barrel. But the most wonderful part of the stomach is its mucous membrane.

The mucous membrane covering the tongue lines the back of the mouth, then passes down the gullet, then lines the whole of the stomach, and then lines the whole of the intestines. We doctors are continually looking at the tongue of our patients; why do we so? It is not to tell us how the tongue itself is, but to tell us how the mucous membrane of the stomach and intestines is. There is a wonderful sympathy between all parts of the mucous membrane, throughout the entire alimentary canal, and when one part is out of order, sooner or later the mucous membrane of the tongue will get out of order too; so by examining the tongue carefully we often can tell how the mucous membrane of the stomach and intestines is. I told you that the mucous membrane of the mouth was everywhere studded with buccal glands. So the mucous membrane of the stomach is everywhere studded with very remarkable tubular glands, whose duty it is to pour out the gastric juice during the digestion of food. When digestion of food is not going on the mucous membrane of the stomach is of a delicate pink colour, and is arranged in longitudinal folds; when the stomach is distended with food these folds disappear.

If we examine a portion of the mucous membrane of the stomach near its cardiac end with an ordinary lens or magnifying glass, we find that its surface presents a peculiar honeycombed appearance, produced by shallow, many sided depressions or pits. In the bottom of these pits are the openings of little tubes which lie side by side, and arranged in a perpendicular manner. Each

little tube is lined by a great number of little cells, which have the power of abstracting from the bloodvessels which lie in the wall of the stomach the materials out of which they make the gastric juice. Each little tube has a number of minute blood-vessels round about it in close contact with it, so that the cells lining the tube can easily imbibe from the blood the materials they require.

Gastric Juice.

These *peptic* glands, as they are called, when food is taken into the stomach, pour out a thin acid liquid called the *gastric juice*, which owes its acidity to the presence of hydrochloric or lactic acid. The gastric juice also contains a very remarkable substance known as *pepsin*. You remember that the cells lining the little sacs of the salivary glands poured out a thin liquid, which is alkaline, during the time the food is being chewed.

When food such as bread and meat, &c., is undergoing digestion in the stomach, the contractions of the muscular coats of the organ roll the food about, and at the same time the gastric juice is being constantly mixed with it.

During the years 1825 to 1832, Dr Beaumont of the United States Army made a great number of observations on the process of digestion. He was fortunate in having a man exactly suited for his experiments. This man's name was Alexis St Martin. He was a Canadian boatman, who had an opening into the cardiac end of his stomach caused by the accidental discharge of a gun. The gun which shot St Martin was loaded with buck shot, and blew away a large piece of the wall of his chest, and made a big hole in the cardiac end of his stomach. This terrible wound healed, but there was left an opening in the skin, which communicated with the interior of the man's stomach. Dr Beaumont used to look into the man's stomach while digestion was going on; and he found out that gastric juice was poured out only when food was in the stomach. Immediately after food is introduced into the stomach, the delicate pale pink mucous membrane becomes red and turgid with blood, and there appear everywhere little minute drops of gastric juice, just like the drops of sweat on a

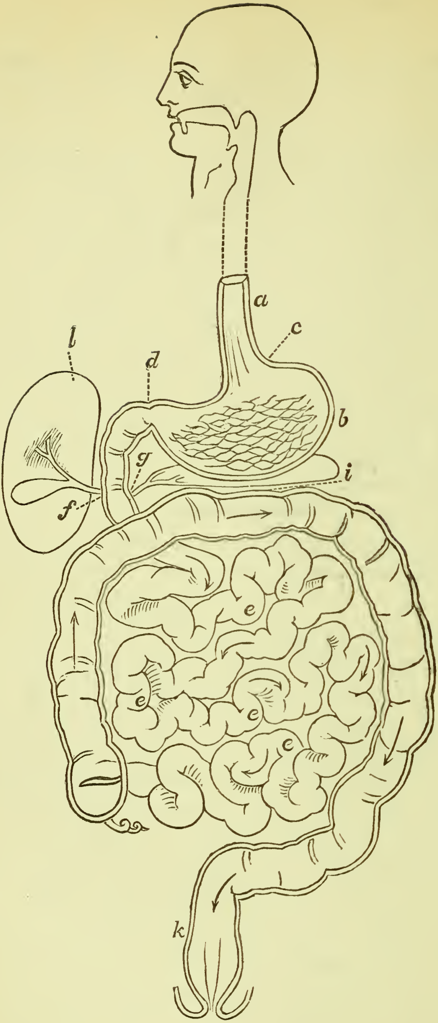
man's brow. These drops gradually run together and flow down the wall of the stomach to soak into the substance of the food.

Dr Beaumont used to put a tube into the man's stomach, and suck out a quantity of the gastric juice, with which he experimented; and he found that if he mixed the juice with meat or white of egg in a glass, and kept it at the temperature of the body, it would digest these substances nearly as quickly as if it were in the stomach. He also used to tie pieces of different kinds of meat on a string, and then pop them into the man's stomach; at different times he pulled out the strings, and noticed how far digestion of the various meats had proceeded. As the result of such experiments, he found that tripe was digested at the end of one hour; roast beef at the end of three hours; roast mutton at the end of three hours and a half. Salt beef took four hours and a quarter, while roast pork took five hours to digest. He also told us that roast turkey was thoroughly digested at the end of two hours and a half. Not many of us get a chance of trying our digestions on roast turkey!

Now, gastric juice will not digest every kind of food. It affects only a single class of food, namely—the nitrogenous food, such as meat and albumen of white of egg, the gluten of bread, the casein of cheese, and such like. It has no effect on starch, or oils and fats; but solid and semi-solid nitrogenous foods are at once attacked and liquified by the gastric juice.

This power of digesting nitrogenous foods depends upon the presence of pepsin and acid in the gastric juice. The effect of digestion in the stomach is to convert the food into *chyme,* which is always a thick liquid, like gruel or thick pea soup, and has a strong disagreeable acid smell and taste. The quantity of gastric juice varies from 10 to 20 pints in twenty-four hours.

The real and important action of gastric juice is to convert the nitrogenous foods into such a state of solution that they can readily pass through the delicate walls of the bloodvessels in the walls of the stomach and intestines. All nitrogenous foods are converted into *peptones.* These peptones always contain nitrogen. When nitrogenous foods have been converted by the action of



Course of food indicated by Arrow.

HUMAN ALIMENTARY CANAL.—*a* Œsophagus. *b* Stomach. *c* Cardiac orifice. *d* Pylorus. *e* Small intestine. *f* Biliary duct *g* Pancreatic duct. *h* Ascending colon. *i* Transverse colon. *j* Descending colon. *k* Rectum. *l* Liver. *p* Pancreas.

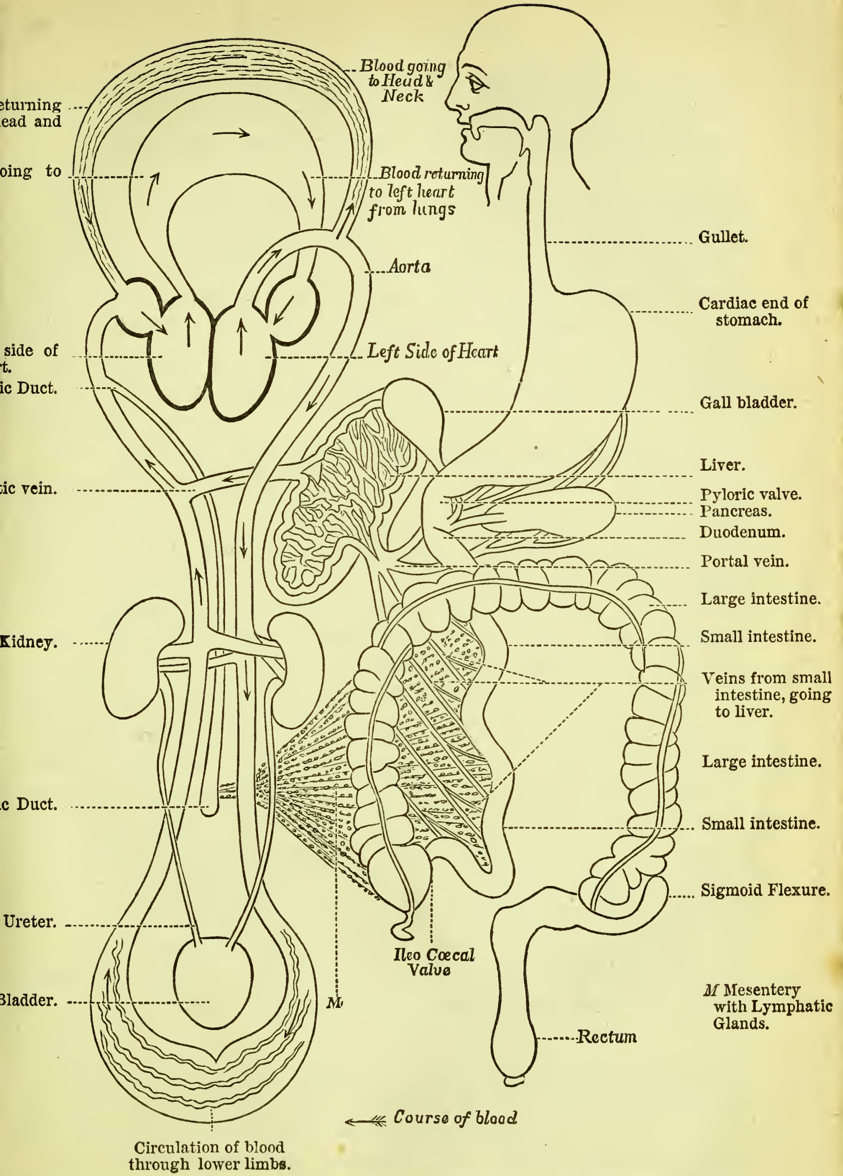


Diagram showing the relation of the Digestive System to the Circulatory System.

gastric juice into peptones, the latter are easily absorbed into the blood, which they were not before being acted on by the gastric juice. Meat, eggs, milk, cheese, &c., are converted into soluble peptones.

Mixed up with the meat we eat there is always a lot of starchy food, such as exists in the potato and bread, and there is always some fat or oily matter in our ordinary diet. On these substances the gastric juice has not any action. They must be attacked and digested by other fluids before they can be absorbed.

Salt and sugar are dissolved by the gastric juice, and may pass at once with the soluble peptones into the bloodvessels in the walls of the stomach.

One remarkable character of the gastric juice, besides those mentioned, is, that it has the power of correcting and preventing putrefaction. Many men like game, "high," as it is called; such flesh is always in a state of putrefaction. The gastric juice corrects this, or else disease would result from eating such flesh. Such starchy material as was well digested by the saliva, along with sugar and salt, is rapidly absorbed by the bloodvessels of the stomach; but there is always a considerable quantity of starchy food that has escaped the action of the saliva.

Digestion of starchy food by the saliva in the stomach is put a stop to by the acid gastric juice, which renders the saliva powerless by neutralising it. All the time digestion is going on the pyloric end of the stomach is tightly closed, but towards the end of digestion the contractions of the stomach squeeze the chyme through the pyloric valve, and it then passes into the intestines. Only a small quantity of the soluble peptones are taken up by the bloodvessels of the stomach. A very large quantity of these rich nutritious peptones are taken up by the bloodvessels in the wall of the intestines, and from thence passed into the blood.

Man does not "chew his cud." I know a gentleman, however, at the present moment, who can bring up food from his stomach into his mouth at will, and chew it over again.

And now we have to consider what takes place after the digested food has passed out of the stomach into the intestines.

Intestines.

The first part of the intestinal tube is called the *duodenum.* It is about 10 inches in length. In man the intestinal canal is about 25 feet in length.

As a rule in flesh-eating animals it is short, and in vegetable-eating animals it is long. In the sheep it is 30 times the length of the animal itself, while in the giraffe the intestine is about 134 feet in length.

The length of the alimentary canal in grass-eating animals is probably owing to the low nutritious character of the food they eat.

The intestinal canal of man is divided into large and small intestines. These two are continuous with each other. The small intestine communicates with the large intestine by means of the *ileo-cœcal* valve, which allows the food to pass from the small intestine into the large intestine, but does not allow it to go in the opposite direction.

The intestinal tube, like the stomach, is covered over by the peritoneum. By means of this covering the coils of the small intestine hang down from the backbone into the cavity of the abdomen. The peritoneal membrane which thus supports the coil of the intestine is called the *mesentery.* It is a double layer, and between the folds are an immense number of bloodvessels, nerves, and lymphatic glands and vessels.

The intestinal canal, like the stomach, has four coats—the peritoneum, the external and internal muscular coats, and the mucous coats; all these structures are continuous with the similar structures of the stomach. The muscular fibres of the external coat run in the direction of the tube of the canal, while the fibres of the internal muscular coat surround the mucous membrane like the hoops of a barrel.

In the mucous membrane of the duodenum are numerous glands called the *glands of Brünner.* They are like little salivary glands, only very small, and they pour out a fluid which mixes with the chyme after it has passed through the pyloric valve of the stomach.

Throughout the entire mucous membrane of the small and large intestine there are imbedded an immense number of small tubes called the *follicles of Lieberkühn.* Each little tube is about the $\frac{1}{360}$ of an inch in diameter, and about five times as long as it is broad. These minute tubes are lined with extremely small cells, which pour out a peculiar fluid called intestinal juice, just in the same way as the glands of the stomach pour out the gastric juice. Now this intestinal juice has the wonderful power of acting on starchy foods in such a way as to convert them into soluble sugar, so that the starchy foods which escaped digestion in the mouth and stomach are now digested by the intestinal juice.

Perhaps the most important structures in the small intestine are the *villi.* On placing a small piece of the mucous membrane in a little water it will be seen to have a velvety appearance; this appearance is caused by the presence of an immense number of minute conical projections of the mucous membrane known as villi. These villi vary in size from the $\frac{1}{40}$th of an inch to the $\frac{1}{12}$th of an inch, but some are not more than the $\frac{1}{120}$th part of an inch in diameter. They cover the whole surface of the mucous membrane.

From the duodenum down to near the end of the small intestine the mucous membrane is arranged in transverse folds, which go nearly round the tube of the intestine. These folds are called *valvulæ conniventes.* They increase enormously the extent of the mucous surface, and as the villi cover the *valvulæ conniventes* as well as other parts of the mucous membrane, some idea may be formed of the great extent of surface there is in the small intestine. It has been calculated there are more than 4,000,000 villi on the surface of the mucous membrane of the small intestine.

The villi have a remarkable structure. Each contains a small artery which breaks up into many small veins, which end in one or more larger trunks, and then pass out of the villus again. In the middle part of the villus is a whitish-looking tube, called a lacteal vessel, which is an offshoot from an immense number of minute lacteal tubes imbedded in the submucous coat of the small intestine. As will be afterwards explained, the lacteal

vessels absorb the fatty portions of food as they pass along the intestine.

The villi hang down from the intestinal mucous membrane, and as the food passes onwards they suck up the liquified portions of it with astonishing rapidity. The rapidity with which they absorb depends very much on the rapidity of the circulation of blood through the small bloodvessels in their interior. By the contraction of the muscular coats of the intestine, the digested food is squeezed onwards, and at the same time the villi are pressed against the passing food, and in this way they are better able to absorb the liquified portions of it. They absorb soluble peptones, soluble sugar, and a certain amount of emulsified fats and oils. The lacteals, however, absorb the greater proportion of the fats when digested. By this wonderful process of absorption the liquified and digested food is taken up by the minute bloodvessels in the villi, and then the veins in each villus convey blood saturated with nourishment into the larger veins which lie between the folds of the mesentery. These latter veins gradually converge upwards to a large vein called the *vena portæ,* which enters the liver at its under part.

At the end of the small intestine there remains little else but the indigestible portions of the food and the refuse of the intestinal secretions. These pass through the ileo-cœcal valve into the large intestine, where they are further acted on by the secretions from the large intestine, and anything that is nutritious is absorbed, while the rest is cast off from the body as useless material.

While the food is passing through the duodenum, it is mixed with the bile which comes from the liver, and with the fluid which is secreted by the pancreas.

The Pancreas.

The *pancreas* is a long, flattened gland, about eight inches in length, and one and a half broad, and nearly an inch in thickness. It lies right across the back bone in front of the large bloodvessel called the *aorta,* and its duct opens into the duodenum near its

lower part. In structure it is like a salivary gland. The fluid secreted by the pancreas has the wonderful property of converting fats and oils into a complete emulsion, by which means they are readily absorbed by the lacteals of the villi, and by the small bloodvessels.

This power of emulsifying fats and oils depends on the presence of a peculiar substance, named *pancreatine*, in the pancreatic fluid. Pancreatic fluid also has the power of converting starch into grape sugar.

The Liver and Bile.

The *bile* mixes with the food in the duodenum just at the point where the pancreatic fluid was poured into the intestine. When freshly poured out, it is of a yellow or reddish colour. It has a strong, bitter taste, and it is neutral or slightly alkaline in its reaction.

The process of secreting bile is continually going on, but it is formed very slowly when one is fasting; when food is being digested, the bile is poured out in large quantity. The amount of bile poured out into the intestines varies according to the amount of food taken, but on an average there is secreted from 30 to 40 ounces in 24 hours.

The bile is formed in the liver by the liver cells. The liver itself weighs between 50 and 60 ounces. It is situated on the right side of the abdomen, and fits up against the under surface of the diaphragm on the right side, just as the cardiac end of the stomach fits up against the under surface of the diaphragm on the left side. It should not be felt below the margin of the ribs on the right side. It has a coat of peritoneum which binds it in its place.

It consists of an immense number of small *lobules* about the twentieth of an inch in diameter, which from mutual compressure have a polygonal shape. Now, each of these lobules consists of an immense number of minute cells, called hepatic or liver cells, whose duty it is to secrete the bile. They vary in size from the $\frac{1}{800}$th to the $\frac{1}{1000}$th of an inch in diameter, and from being pressed together they are polygonal in outline.

These little liver cells extract from the blood the material out of which bile is made, just as the cells in the peptic glands extract from the blood the material out of which the gastric juice is made. In each lobule there is an extraordinary capillary network of minute veins, which come from several branches or offshoots from the large vena portæ. Now you remember the vena portæ is the large trunk formed by the union of all the veins coming from the stomach, pancreas, and intestines. It is a large vein which enters into the liver on its under side, and conveys to the liver the blood which comes from all the organs of digestion, and this blood is loaded with the absorbed products of digestion.

This vena portæ gives off numerous small branches which pierce each lobule, and then split up into an extraordinary mesh of extremely small veins. In the mesh work thus formed lie the little liver cells. By this arrangement the liver cells are brought into close contact with the blood, as it flows through the minute veins; and they are thus better able to imbibe from the blood the materials they require to manufacture into bile.

After the bile has been manufactured from the blood by these little liver cells, it is passed into small vessels or tubes called hepatic or *bile ducts*, and these convey it to the bag called the gall or bile bladder, and in this bag it is stored up when digestion is not going on; but when digestion is going on, the bile is constantly poured out into the intestine, as I have described. But what becomes of the blood in the extraordinary mesh-work of veins after the liver cells have done their work? Why, in each lobule it is again collected into one small venous trunk, which leaves each lobule, and then joining a great number of other such trunks, all together form one large vein called the hepatic vein, whose duty it is to carry the blood thus deprived of the elements of bile into a large vein, the inferior vena cava as it is called, leading directly to the right side of the heart. From the right side of the heart the blood is pumped to the lungs to be further purified, where we shall leave it for a short time.

Please do not suppose that the bile is brought to the liver ready made and then extracted by the liver cells. It is not so. The blood which enters the liver by the portal vein contains no bile, but

this fluid is entirely manufactured by the minute liver cells, in very much the same way as the other secreting cells in the different glands manufacture their secretions. It is indeed a wonderful process. In these liver cells lies the power of extracting such material as they require for the manufacture of bile. The bile is very rich in hydrocarbons—that is, substances composed of the elements hydrogen and carbon. Thus a piece of dried bile will readily burn away if lighted in a flame. As a rule no bile is to be found in the blood, but sometimes the mucous membrane of the duodenum in the neighbourhood of the gall bladder's orifice becomes swollen and inflamed. Then the duct of the gall bladder, which has a very small opening, gets blocked up, and the bile, somewhere behind the point of obstruction, is apt to be absorbed into the blood. When there is bile in the blood the white of the eye at once shows a yellow tinge, and the skin may become as yellow as a guinea. The person thus affected is then suffering from *jaundice.*

Now for what use is the bile? It is important to remember that it is poured into the intestine at its upper part, so that it mingles with the chyme directly after it leaves the stomach. Now this arrangement clearly shows that the bile has some important relation to the food with which it is mixed. There is little doubt that the bile is, in the first place, an excretion—that is to say, the bile is the means of purifying the blood coming from the organs of digestion. It takes from the blood a large quantity of impurities which, if they passed on into the general circulation, would be injurious to the body. The liver is placed as a filter between the organs of digestion and the right side of the heart, and without doubt, one of its chief duties is to filter the blood of those materials which collectively make the bile. But the bile, when once formed, has important digestive functions, of which the chief are—

1*st.* It assists in emulsifying the fatty portions of the food, and thus makes them more easily absorbed by the lacteals in the villi.

2*d.* By moistening the mucous membrane of the intestines the fatty matters of the food are more readily absorbed.

3d. It has a marked antiseptic power like the gastric juice. When thoroughly mixed with the food it prevents its decomposition, and the formation of gas in the intestine.

4th. As it passes down the intestine it seems to stimulate the follicles of Lieberkühn to pour out their secretions more copiously; and it also stimulates the muscular coats of the intestine to contract, and thus to drive onwards their contents.

After the bile has done its duty in assisting digestion, it undergoes some peculiar changes in composition, and is re-absorbed into the blood, and being a highly hydrocarbonaceous material it is oxidized, and by its combustion helps to maintain the heat of the blood.

But there is another wonderful function performed by the liver, and that is the formation of a substance which readily is converted into grape sugar. A Frenchman, Claude Bernard, 1848, after a number of experiments, found that a substance named "glycogen," or "sugar former," was manufactured in the liver cells, and that this substance rapidly became converted into sugar, and passed into the blood in the form of grape sugar, and by the oxidation of this sugar in the lungs the heat of the body is kept up.

This formation of glycogen in the liver is a normal process, and so is its rapid conversion into sugar. Sometime so much sugar is thus poured into the blood that some of it appears in the secretion from the kidneys, constituting the disease called "Glycosuria." The well-known disease *Diabetes mellitus,* in which a large quantity of sugar is daily found in the secretion from the kidneys, has some close relation to the normal glycogenic function of the liver.

Let me now, in conclusion, give a summary of the changes which take place in the food during its passage through the stomach and small intestine. In the stomach the food is thoroughly mixed and converted into a uniform mass. It is saturated with the gastric juice which dissolves the nitrogenous portions of it. The conversion of the starchy food into sugar, which began in the mouth, is now almost stopped in the stomach, and the

fatty matters are thoroughly mixed up with the other constituents of food, but as yet they are not digested in the least. Soluble matters, such as sugar and salt, and those substances which have been rendered soluble by the action of saliva and the gastric juice, have begun to be absorbed by the bloodvessels in the wall of the stomach, and such fluids as wine and water also begin to disappear. That thick pea-soup liquid, the chyme, which results from the gastric digestion, is being continually squeezed through the pylorus into the duodenum. It consists of nitrogenous matters broken down and half dissolved, fatty matters broken down but not dissolved at all, starchy matters being slowly converted into sugar, and being dissolved in the fluids in which they are mixed as soon as they are converted into sugar. When it passes into the duodenum, the chyme is further mixed with fluid secreted by Brünner's and Lieberkühn's glands, and then with the bile and pancreatic juice. Now all these liquids have a more or less alkaline reaction, and by being mixed with the chyme the acidity of this latter becomes less and less, until, at the middle of the small intestine, it is decidedly alkaline in its reaction. In the upper part of the small intestine the fatty parts of the food are converted into an emulsion—that is, fat is converted into exceedingly minute particles, which are readily absorbed.

Those nitrogenous substances which were partly dissolved in the stomach are still further acted on by the gastric juice, and they are converted into soluble peptones, which are capable of easy absorption. The starchy constituents of the food are now rapidly acted on by the pancreatic and intestinal juices, and the sugar thus formed is quickly dissolved in the fluids, and is absorbed chiefly by the bloodvessels of the villi. The fatty emulsions are absorbed chiefly by the lacteals in the villi. As this fatty emulsion flows through the lacteals into the larger lacteal vessels it is called *chyle*. The epithelial cells covering the surface of the villi seem to pick up the minute fatty molecules and then pass them on into the lacteal vessels. The chyle flows in the lymphatic or lacteal vessels through the mesentery, and then is acted on by the lymphatic glands, which are very numerous in this situation. As the chyle leaves the mesenteric glands it

is much altered in physical characters, and contains a number of corpuscles, which gradually pass into blood corpuscles.

The chyle at last passes into a long tube, called the *thoracic duct*, which leads into the large veins entering the right side of the heart. In this way the fatty emulsified foods are carried into the blood, and there they become saponified or converted into a soapy material, which diffuses thoroughly with the blood. Those nutritious substances which have been absorbed by the bloodvessels of the stomach and intestines pass in the veins up towards the liver, and as the blood, rich in nutriment, passes through the liver, bile is manufactured from it, and the blood is thus purified. The blood then passes into the inferior vena cava, and then into the heart, from whence it is pumped to the lungs. Here it is acted on by the oxygen of the air. A large quantity of carbonic acid and watery vapour is excreted, and the blood, rich in nourishment and purified, is now sent by the contractions of the left side of the heart all through the body. It flows from the large bloodvessels into the smaller ones, and then into the myriads of minute capillaries. Here the cells or ultimate structures of each tissue, such as bone, brain, muscle, &c., abstract or imbibe from the blood the materials they require for their nutrition, and for the performance of their functions. Thus the cells of the brain extract material from the blood, and there can be no doubt that if they did not get the material they require there would be no manifestations of mind. The muscles and bones and different organs of the body take only the materials they require. Recollect it is the minute cells in each tissue that select these materials, and that before they can do so the blood must be spread out into the millions of capillaries which permeate every tissue. While the blood is thus giving out nourishment for the nutrition and growth of the various tissues of the body, it also takes in the effete or used up material, the ashes, as it were, that remain after work has been done, and passing onwards loaded with impurities it arrives again at the lungs, where carbonic acid and moisture are again thrown off. It arrives at the skin, where much moisture and animal matters are thrown off, and as it circulates through

the kidneys a large quantity of the effete nitrogenous materials is thrown off in the form of *urea.*

It is the minute cells in the different tissues and organs of the body that do all the work. They require to be well fed. The object of the circulation of the blood is to take nourishment to them, without which they could not work. All work implies waste. The circulating blood while it feeds the cells takes from them the waste materials. The waste materials consists chiefly of hydrogen and carbon. These are got rid of from the blood by breathing fresh air or oxygen, and by taking plenty of exercise, by which means an enormous quantity of carbonic acid gas, with moisture and animal matters, is thrown off from the blood.

In conclusion, compare the original germ or egg with man as we have now seen him. What a wonderful change. And yet every tissue of his body is made up of cells, which are the descendants of the original germ. Can you wonder at my endeavour this evening to fix your attention on the marvellous powers of these small cells? Do all you can to live strictly in accordance with the best rules of health. Try to preserve the lives of these little cells by living temperately, with due regard to exercise and cleanliness. And never forget that your life is made up of the lives of these little cells, and if they perish you perish also.

SMALL-POX AND VACCINATION.

By D. RUTHERFORD HALDANE, M.D., P.R.C.P.

We are all more or less painfully aware that we are subject to a variety of diseases, though the causes which give rise to them are often very obscure. Diseases do not occur spontaneously; if no morbific causes were in operation the organism might go on working smoothly until it was worn out, for I need not say that the body is only designed to have a limited duration. But as a machine is exposed to a variety of accidents which may affect its acting, and lead to its derangement, so the body is surrounded by causes of disease. If we had not a certain power of resisting these causes, we should be constantly ailing, and there are great differences in the power of resisting, not only between different individuals, but in the same individuals at different times. This greater or less power of resistance constitutes what is called the lesser or greater susceptibility to disease.

The causes of disease may be divided into two great heads, the general and the specific. The general causes are those which are constantly in operation around us, which do not act unless they are in a certain degree of intensity, and which often act rather by weakening the body and making it more susceptible, than by producing any definite disorder. Among these general causes we include age, sex, occupation and mode of life, climatic and atmospheric influences, and the like. As an illustration of the mode of action of these general causes, let me take a familiar example; what do we mean by catching cold? A person is said to have caught cold when, after exposure to a lowered temperature, combined usually with the chilling influence of air in motion, and often aided by a moist atmosphere, removal of heat from the sur-

face of the body has taken place to an unusual degree, and when in consequence a disorder, trifling or severe, has been set up. Now it is not the cooling of the surface which is the direct cause of the disease, for the effects are not usually local, but show themselves in remote situations. Suppose several people sit in a draught; of these, a certain proportion, probably the majority, will escape altogether; of the rest, some may suffer from sore throat, earache, toothache, or rheumatism; others from feverishness, catarrh, pleurisy, or some other internal inflammation. It is evident that there has been nothing specific in the cause, for it has given rise to very different symptoms in different individuals. What has taken place appears to be this. When the skin is exposed to a sufficient degree of cold for a sufficient length of time, a peculiar impression is made on the nerves of the part, of which impression the individual may or may not be conscious; this impression is conveyed along the nerves to the centres in the brain and upper part of the spinal cord, and is then reflected, as it is called, along other nerves to various parts of the body. Now the effects will vary according to the susceptibility of the individual. If there is a susceptibility of his sensory nerves, this will show itself in rheumatic pains or neuralgia; if of the nerves of the bloodvessels and of nutrition, in various congestive or inflammatory affections; if the susceptibility be in the centre which regulates heat, fever may result. It will thus be seen that cold has not produced any uniform or specific effect; the effects upon different persons have varied according to their susceptibility, that is to say their greater or less power of resistance. The other general causes of disease act in essentially the same way.

With the specific causes of disease it is different. These are of the nature of poisons, and if they act at all, act always in the same way; the symptoms produced by them may vary in severity, but not in character. But there is one very remarkable peculiarity which distinguishes them from the ordinary poisons of the vegetable and mineral kingdoms. The effects of an ordinary poison depend essentially upon the amount introduced into the system, and they are in fact not poisons at all unless a certain minimum dose has been exceeded. Thus, many of the most

energetic poisons, such as opium, arsenic, prussic acid, strychnia, and others, are in small doses most valuable medicines, and it is only when the dose is increased beyond a certain point that we get dangerous effects. As soon as a poison is introduced into the body, nature endeavours to eliminate it, and within certain limits will be successful in doing so; but if the quantity has been too large, the organism is overpowered, and death is the result. The specific animal poisons act in a different way; the amount of the poison taken into the system makes little or no difference on the effect produced, as the virus possesses the property of multiplying itself almost indefinitely. When an unprotected person is exposed to the poison of small-pox, he inhales a certain amount of air containing emanations from the sick person. The poison almost certainly exists in the form of very minute bodies floating in the air, so minute as to elude our most delicate means of research. At first no apparent effects are produced in the recipient of the poison; he may go about as usual; he may entirely forget his exposure to the disease; and it will not be until after an interval of ten or twelve days that he feels really ill. During this time, which is called the latent period, the poison has been going on multiplying within the system, and it is only when the development has proceeded to a certain extent that definite symptoms show themselves. Of the extent to which the poison has multiplied we can scarcely form an idea. The amount of the small-pox poison originally introduced was infinitesimally small, but in a bad case when the disease is at its height, the patient is covered from head to foot with countless pocks, from any one of which several persons might be inoculated; all his secretions are tainted; the atmosphere around him is teeming with the poison which is being constantly given off.

Another great peculiarity of these specific diseases is that one attack generally protects a person from the recurrence of the same disease. We know that comparatively few persons have small-pox, measles, scarlet fever, or hooping cough a second time. This is explained in the following way: in most persons there naturally exists in the blood a something which makes it a suitable soil for the multiplication of the poison; but when this multiplication has

once taken place, that is when the person has gone through one attack of the disease, this something is destroyed, and unless it is again formed, which is always a tedious process, the person is insusceptible to a recurrence of that disease. You know in a general way what takes place in ordinary fermentation, such as the making of beer. The barley is first malted, and during the process a large quantity of sugar and starch is formed. The malt is ground or bruised, and by the action of warm water all the soluble matter is extracted. To this solution or wort, yeast is added, and very soon the fluid passes into a state of commotion or fermentation, much gas is given off, a large amount of new yeast is formed, and the sugar of the wort is converted into carbonic acid and alcohol. The process of fermentation comes to an end so soon as all the sugar has been so converted, and it is evident that it could not be again set agoing unless a fresh quantity of sugar were added. Yeast, I may state, is a substance in a state of change, containing an immense number of microscopic vegetable cells, which are undergoing rapid growth. When the yeast is introduced into the wort, the growth of cells goes on more rapidly, for their development is an essential part of the process. After a time this cell growth reaches a climax, then declines, and at last dies out. All this is very analogous to what occurs in the case of the specific poisons; there exists in the blood something analogous to the sugar in the fermentable fluid ; the poison corresponds to the yeast and multiplies within the body until the whole of *the something* has been destroyed or converted ; and when this has once taken place it can only be renewed, if ever, after the lapse of a long time.

The last peculiarity I shall mention with regard to the specific diseases is, that each of them is produced by a special poison, that they are propagated by infection or contagion, and that so far as we know the poison is never spontaneously produced; that is to say, while the vast majority of diseases such as inflammations and the like may be produced by a variety of causes, small-pox and the other specific diseases can only be produced by the communication of the poison from the sick to the healthy. It is often difficult or impossible to trace the communication, but when it is

borne in mind that the poison exists in an almost impalpable form, and that it may under certain circumstances retain its properties for an almost indefinite period, our difficulties with regard to exceptional cases will disappear.

I fear I have wearied you by these somewhat abstract consider ations, but I hope they may prove conducive to the better under standing of the proper subject of my lecture, upon which I now proceed to enter.

Of the specific diseases of which I have been speaking, small-pox is the most important, although fortunately its ravages are far more limited than they were prior to the introduction of protective measures. It seems quite unnecessary for me to give any description of the disease, but I have no doubt you are all aware that it is one of the most dangerous and loathsome maladies which afflict mankind. Of the origin of small-pox we know little or nothing; it appears, however, to have come from the East, and to have been known in China and Hindostan from time immemorial. It is said that in India, long before the Christian Era, a particular goddess had been worshipped as a protectress against it. The disease slowly travelled westwards, for communication was very tardy in those days, and it seems to have reached Constantinople by way of Egypt about the year 569, the year of the birth of Mahomet. From Constantinople it spread gradually over the whole of Europe, having reached England about the middle of the thirteenth century, while Sweden was not visited till two hundred years later.

In Europe small-pox long constituted one of the greatest scourges of the inhabitants, and in the present day we can have no idea of the terror with which it was regarded. It was more dreaded than the Plague, and the treatment of the disease previous to the time of the great English physician Sydenham, was not calculated to diminish the mortality. The treatment consisted in endeavouring to "drive out the poison," in encouraging perspiration by enveloping the patient in thick flannel, in carefully excluding every breath of fresh air, and in the administration of hot drinks.

In the eighteenth century, when the population was much

smaller than at present, it is calculated that 500,000 died of it in Europe annually. In France the annual mortality was 80,000; in England, 7 to 9 per cent. of all deaths were attributable to it. A good illustration of the prevalence of small-pox is afforded by a proverb well known at that period, "From small-pox and love, but few remain free."

The ravages of the disease were still more terrible when it was for the first time introduced into a new country, especially if that country were within the tropics. Small-pox was unknown in America at the time of its discovery by Columbus in the year 1492; it was introduced by the Spaniards, and first showed itself in Mexico in 1527, and is said to have cut off at that time three millions and a half of the inhabitants. Thence it gradually overran the whole of America. It is believed that nearly one-half of the North American Indians were cut off by it; powerful tribes were almost exterminated. Perhaps a still better idea of the malignancy of the disease may be obtained by observing how many deaths it caused among the royal families of Europe, who, it is reasonable to believe, were surrounded by all known precautions against it. Joseph the First of Austria and Mary Queen of England died of it; and in the course of the eighteenth century it cut off two empresses, six archdukes and archduchesses, an Elector of Saxony, and the last Elector of Bavaria.

When the terror regarding small-pox was at its height, news came to this country that in Turkey a means was known for moderating the severity of the disease. This means was inoculation, and consisted in taking a little of the small-pox matter on the point of a needle and introducing it below the skin. The result was that the disease was communicated to the person inoculated, though generally in a very mild form. This operation seems to have been practised from time immemorial in China and India, and to have slowly travelled westwards till it reached the shores of the Levant and Turkey.

Early in the last century the news of this discovery first reached England; a description of it was given by several medical men, but at first no attention was paid to it. It was to Lady Mary Wortley Montague that her countrymen were indebted for having

introduced this practice into England. Lady Mary had accompanied her husband to Turkey, where he was ambassador, and she there heard of the process for the first time. Small-pox was a disease which she had good reason to dread; her only brother had been cut off by it, and she herself had had a severe attack, so much so, that it was thought she would be permanently disfigured. Though this did not happen, the disease left tokens of its passage, for it deprived her of her very fine eyelashes; a deprivation, it is said, which gave a fierceness to her eyes which impaired their beauty. She watched the Turkish process with peculiar interest, and was so satisfied by what she saw and heard that she had her only son, a child of three years old, inoculated in 1718. The operation was quite successful, and from a letter of Lady Mary to a friend, written shortly before, I may be allowed to make the following quotation:—"I am going to tell you a thing that I am sure will make you wish yourself here. The small-pox, so fatal and so general among us, is here entirely harmless, by the invention of *ingrafting*, which is the term they give it. There is a set of old women, who make it their business to perform the operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the small-pox; they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nut-shell full of the matter of the best sort of small-pox, and asks what veins you please to have opened. She immediately rips open that you offer to her with a large needle (which gives you no more pain than a common scratch), and puts into the vein as much venom as can lie upon the head of her needle, and after binds up the wound with a hollow bit of shell; and in this manner opens four or five veins. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have very rarely above twenty or thirty pocks in their faces, which never mark; and in eight days' time they are as well as before their illness. Every year thousands undergo this operation; and the French Ambassador says, pleasantly,

that they take the small-pox here by way of diversion, as they take the waters in other countries. There is no example of any one that has died in it; and you may believe I am very well satisfied of the safety of the experiment, since I intend to try it on my dear little son."

Lady Mary returned home in 1721, and her daughter was the first person ever inoculated in England. In the course of the following year the Princess of Wales had her two daughters, the Princesses Amelia and Caroline, inoculated, after the process had been successfully tried upon six condemned criminals in Newgate. There was a special reason for the anxiety of the Royal Family with regard to small-pox. Queen Mary, wife of William the Third, died in 1694 of malignant small-pox at the age of thirty-two, to the intense grief of her husband, and the profound sorrow of the nation. In 1721, George the First had recently come to the throne, and the direct succession of the Hanoverian line was of the utmost importance to the Court and to the nation. Queen Mary's death had made a deep impression, which had not subsided after the lapse of five-and-twenty years. Inoculation, introduced into England under such favourable auspices, gradually spread, and was doubtless the means of saving many lives.

We are not, however, to suppose that the new system was allowed to spread unopposed. Far from it; it was denounced as dangerous, precarious, immoral, and irreligious. It was said to be acting in opposition to Providence, by attempting to take the progress of events out of higher hands. It was declared to be unprotestant, because it had come from Turkey. Though opposed both by the medical profession and by the clergy, it was among the latter that its bitterest opponents were found. The Rev. Mr Massey preached a sermon against it in St Andrews, Holburn, in which, to quote the words of a contemporary writer, having selected his text from the book of Job, he inveighed against the dangerous and sinful practice of inoculation, treated the inoculators with the most unqualified abuse, calling them diabolical sorcerers, hellish poisoners, enemies of mankind, and expressed the hope that they would be distinguished from those of the medical faculty who deserve honour, and not be permitted to

mingle with them, as the devil among the sons of God. He considered inoculation to be a very ancient art, and to have first been put in practice upon Job by the devil, who, by some venomous infusion into the body of Job, had raised his blood to such a ferment that it threw out a confluence of inflammatory pimples all over him from head to foot, and that truly he had conveyed it to him by the way of inoculation.

Gradually, however, prejudices were got the better of, and the practice of inoculation became pretty general among the upper and middle classes, with the effect of rendering small-pox much milder among those who were submitted to the operation. Whereas formerly about one in every five cases of small-pox died, the mortality among the inoculated was not greater than one in fifty. How it is that inoculation produces a mild form of small-pox we do not know. You will have observed that the essential peculiarity in regard to it is that the small-pox poison is introduced directly into the blood, instead of entering the system by the lungs or some other channel. Now, as a rule, medicines or poisons act more energetically when introduced directly into the blood than when swallowed, and you may have heard of a new mode of administering active medicines by what is called subcutaneous injection. When this method is employed, a smaller dose is required, and the medicine acts more rapidly; but in the case of inoculation, the direct introduction of small-pox matter into the blood, contrary to all analogy, diminishes the virulence of the poison. But a great objection to inoculation was soon discovered. It had been hoped that small-pox induced by it would not be infectious, but it was soon found that this was not the case, and consequently the effect was to disseminate small-pox throughout the country more widely than before. Previous to inoculation, epidemics of small-pox only occurred occasionally, the disease almost disappearing in the intervals; but now every inoculated person became a new centre of contagion, and those who were not inoculated were actually in greater danger than before. The process of inoculation could never have become general, and it appears from evidence laid before Parliament, that though it was a great protection to those on whom it was per-

formed, it was a great source of danger to others, so that on the whole the total mortality had been rather increased than diminished by it. It appears that just before the introduction of vaccination, when inoculation was as general as it was ever likely to become, the annual mortality from small-pox in the United Kingdom was 36,000. Accordingly, in the year 1840, inoculation was made illegal by Act of Parliament.

We now come to vaccination, the discovery of which will for ever be associated with the name of Edward Jenner. Jenner was born in the vicarage of Berkeley in Gloucestershire, on the 17th of May 1749. The little town of Berkeley, in the centre of the vale of the same name, is situated near the Severn, in one of the richest pastoral districts of England, which produces the well-known double Gloucester cheese. Jenner was educated in his native village, and in due time was apprenticed to a surgeon in Bristol. He appears to have been of an inquiring disposition, and to have early shown a predilection for Natural History. In this great dairy district it was a matter of frequent observation that those engaged in milking were occasionally subject to sores on their hands similar to those which were found upon the udders of the cows. There was also a popular superstition, for it cannot be called anything more, that those who suffered from this eruption thereby obtained a protection against small-pox, at that time the most fatal and the most dreaded of diseases, but no attempt had been made to investigate the matter any farther. While still an apprentice Jenner had heard of this popular opinion, and it seems at once to have made an impression upon him. At this time, however, he had no opportunity for prosecuting his inquiries, and when, after a residence in London, he returned and settled in his native place, he found that there were great difficulties in the way of his investigations. He persevered, however, and about thirty years afterwards his inquiries resulted in the full establishment of vaccination. Now this was no accidental discovery. Others had heard the opinion of the milkers but had paid no attention to it; Jenner himself had mentioned it to some of his friends, among whom he ranked several of the most distinguished men of his day, but they

seem to have at first looked upon him as an amiable enthusiast. It must be remembered that there were very serious difficulties to be overcome. Jenner soon found that the cows were often free from disease, and it was then impossible to make any experiments; he then found that the cows were subject to several eruptions which were communicable to the milkers, but that only one of these afforded a protection against small-pox; he next discovered that when the true disease was present the matter required to be taken from the pustule at a particular period; and finally, he made the brilliant discovery that it was not necessary that the protecting material should be taken directly from the cow, but that it could, without impairment of its virtue, be passed on from one human being to another. Most discoveries have had, or are believed to have had, in them something of the romance of accident. Newton is said to have been led to his grand discovery by seeing an apple fall from a tree, while he sat meditating in his garden; Watt is supposed to have first had his attention directed to the expansive power of steam, by noticing on a winter evening the lid of a tea-kettle raised by the vapour of the boiling water. It would be as unjust to say that the discovery of gravitation or of the steam-engine was accidental, as to deny to Jenner the full merit of having worked out his great discovery of vaccination in a thoroughly scientific manner.

In June 1798 Jenner's researches were made public, and from that time we may date the establishment of vaccination.

It was not to be expected or even desired that the announcement of a discovery which bade fair to revolutionise a whole department of medicine, should be received without opposition. We have seen that in the case of inoculation the clergy were its bitterest opponents, but on the introduction of vaccination its warmest enemies were members of the medical profession. We know what a powerful motive self-interest is, and on the announcement of vaccination it was not surprising if the self-interest of the medical profession took alarm. In those days small-pox was no inconsiderable source of revenue to the Faculty, not only to the physician but to the surgeon; for while the former claimed the treatment of small-pox as being an internal

disease, on the latter the duty of inoculation, and not unfrequently the subsequent management of the case, devolved; and when the craft by which we have our wealth is in danger, all are ready to cry out with the silversmiths of old, "Great is Diana of the Ephesians." On the whole, however, the reception which vaccination met with is, I consider, very creditable to the medical profession; a few at first bitterly opposed it, but the great mass of practitioners, as soon as they were satisfied of its value, became its warm supporters.

As I have quoted some of the arguments of the clergy against inoculation, it is only fair that I should give you some specimens of what was said by medical practitioners in opposition to vaccination. The argument upon which most weight was at first laid was, that vaccination being derived from the cow, introduced into the human system new and bestial diseases. Thus it was gravely maintained that diseases previously confined to the bovine race had been communicated by means of vaccination. It was asserted that cow-pox, mange evil, abscess, blotches, beastly ulcers, and other diseases of brute beasts, had been incorporated with the human constitution. These statements were not confined to vague generalities, numerous specific instances were appealed to. Everybody might have heard of William Ince, who, it was asserted, had become since his vaccination covered with patches of hair like a cow. There was a little girl, Polly Ringrose, who, poor thing, was not only becoming hairy all over, but coughed like a cow, and squinted as only cows squint. There was Miss Mary Ann Lewis, the cow-poxed, cow-manged young lady, and Master Jowles, the cow-poxed, ox-faced boy. Above all there was an unfortunate child at Peckham, whose naturally fine disposition had become brutal, who went about upon all fours, bellowing like a cow, and butting with his head like a bull.

Such assertions in the present day seem simply ridiculous, but they had their weight at the time, and had no doubt some effect in retarding the early progress of vaccination. I have no doubt that the objections still brought forward against vaccination, will at no distant date be considered as frivolous

as these. It is a remarkable fact that the opposition to vaccination was more violent in England, where it was discovered, than in any other country. No doubt this was owing to the political freedom of Great Britain, which permits empiricism and many species of imposture to flourish, which are either restrained or suppressed by the more rigid laws of other states. Perhaps, as Dr Moore, one of the historians of vaccination, observes, "the facility for controlling such evils and of punishing knaves is some compensation for the loss of the blessing of liberty."

What the precise relation is which vaccine matter bears to small-pox, we do not altogether know. We know that the cow is subject to a local eruptive disease, which when introduced into man constitutes vaccinia, and is protective against small-pox; and we know that the inoculation of human small-pox lymph into cows produces vaccinia, but that human small-pox and cow-pox are identical, though highly probable, cannot be said to be altogether proved. This much, however, is certain, that the two are closely allied, and the practical point is that by vaccination we substitute a mild and local for a virulent constitutional disorder.

In spite of all that has been said by its opponents, no unprejudiced person can doubt as to the efficacy and value of vaccination. In countries where it has been introduced and systematically carried out, the number, the intensity, and the extent of small-pox epidemics have been remarkably diminished, and in a manner which makes the idea of mere coincidence utterly inadmissible. One fact is a sufficient illustration of this. In London alone, during the eighteenth century, the annual mortality from small-pox was from 3000 to 4000. In the ten years 1845 to 1854, when the population was enormously increased, the average annual mortality was about 340, and if vaccination had always been properly attended to, it would have been even smaller. At its first introduction, when the fear of small-pox was strong, vaccination was very generally taken advantage of, but as the pestilence was kept in check persons became indifferent, and the protective means was often neglected. I may mention that it was not til

1853 that vaccination was made compulsory in England, and not till 1864 that this provision was extended to Scotland. By the law as it now stands, every parent must have his child vaccinated within six calendar months of its birth, and the vaccination must be repeated until successful, unless the child be found to be insusceptible. Another circumstance which proves the protective power of vaccination is that where the vaccination of adults, as in the Prussian army, has been regularly performed, epidemics of small-pox no longer occur. The trial of re-vaccination in that army has conclusively demonstrated the efficacy of the measure, to test which we have merely to compare the immunity of soldiers during epidemies of small-pox with the mortality in classes of the same general age in the civil community, among whom re-vaccination is not systematically carried out.

Another advantage obtained from vaccination is, that it not only saves many lives, but that it prevents much weakness, suffering, and deformity. Small-pox is not only directly dangerous to life, it is very apt to be followed by troublesome consequences or sequelæ. Of persons who suffered from the natural small-pox a considerable number remained permanently debilitated, never regaining their former strength. If any scrofulous or consumptive tendency existed, it was very likely to be called into activity. Another risk was permanent loss of sight or of hearing, particularly of the former. Inflammation in small-pox very often attacks the eyes, and permanent blindness is frequently the result. Few children are born blind; in the great majority of cases blindness is due to the destruction of the eyes by inflammation in early life. Before the introduction of vaccination the great proportion of the blind had lost their sight in infancy in consequence of small-pox. It was calculated in the last century that three-fourths of the cases of blindness in blind asylums were due to small-pox. From this danger effectual vaccination is an almost absolute protection. Finally, small-pox was formerly very much dreaded, in consequence of the permanent marking which a severe attack of the disease left behind it. Unfortunately, such cases are still occasionally met with; but in the days of our great-grandfathers there were comparatively few families in which some

pretty face had not been made plain, some fine complexion destroyed.

Lady Mary Wortley Montague, to whom I have already referred, was not only a very beautiful, but a very clever woman. During the course of her life she wrote a good many poems which have since been collected, and have had a tolerably wide circulation. Among these is one entitled "The Small-pox," in which a lady, who is convalescent from that disease, describes her feelings on looking into her glass for the first time. From this I may be allowed to quote a few lines :—

"The wretched Flavia, on her couch reclin'd,
Thus breath'd the anguish of a wounded mind,
A glass revers'd in her right hand she bore,
For now she shunn'd the face she sought before.
'How am I chang'd! alas! how am I grown
A frightful spectre to myself unknown!
Where's my complexion? where my radiant bloom,
That promis'd happiness for years to come?
Then with what pleasure I this face survey'd!
To look once more my visits oft delay'd!
Charm'd with the view, a fresher red would rise,
And a new life shot sparkling from my eyes!
'Ah! faithless glass, my wonted bloom restore;
Alas! I rave, that bloom is now no more!
The greatest good the gods on men bestow,
Ev'n youth itself to me is useless now.

. . . .

Ye cruel chemists, what withheld your aid?
Could no pomatum save a trembling maid?
How false and trifling is that art ye boast!
No art can give me back my beauty lost.

. . . .

Galen, the grave, officious squirt was there,
With fruitless grief and unavailing care;
Machaon too, the great Machaon, known
By his red cloak, and his superior frown;
And why, he cried, this grief and this despair?
You shall again be well, again be fair;
Believe my oath (with that an oath he swore);
False was his oath; my beauty was no more!

. . . . .

Adieu ! ye parks—in some obscure recess,
Where gentle streams will weep at my distress,
Where no false friend will in my grief take part,
And mourn my ruin with a joyful heart ;
There let me live in some deserted place,
There hide in shades this lost inglorious face.
Plays, operas, circles, I no more must view !
My toilette, patches, all the world adieu !'"

The last benefit conferred by vaccination is that it gives us the means of getting rid of small-pox altogether. Small-pox, as I have already said, differs from most diseases in this, that it is only propagated by contagion ; it never, so far as we know, arises anew. Various fevers and other diseases are produced by over-crowding, bad drainage, and other general causes, but small-pox never seems to be produced in this way. All we know of its history shows that it has always been imported. It came to us from the East, and we can trace its importation into America in 1527, about thirty-five years after its discovery. It was unknown in Australia and New Zealand for many years after their discovery, and is said to have been imported into the former country by the steamship the *Great Britain.* Now if every one were protected by efficient vaccination small-pox could no longer spread, as no one would be susceptible of the poison, and thus the disease might in course of time be literally stamped out.

In spite of the incalculable benefits which have been conferred by vaccination, there is still a certain number of persons who oppose it on various grounds, and Anti-Vaccination Societies have been established with a view to influencing the legislature to cease to render vaccination compulsory. As this lecture is not intended to be of a controversial character, I shall refer to the objections in the briefest possible manner.

The grounds on which vaccination is opposed are various. In the first place, it is said to be unnatural, and even irreligious, to introduce a disease into the system with the object of protecting it from a malady to which it may never be exposed. The answer is simple: before the introduction of vaccination small-

pox was almost always more or less epidemic; and as we have seen, the most exalted rank afforded no immunity from its attacks; and were vaccination discontinued this state of matters would soon be restored. As to being unnatural: our life is now so artificial that it is difficult to say what we do that *is* natural. It is unnatural to wear clothes, to cook our food, or to avail ourselves of the services of the lower animals for purposes of transport or locomotion; but are not these unnatural actions the very proofs of advancing civilization? There is in man an irresistible impulse to rise above the condition of the savage; and it is this very instinct which distinguishes him from the beasts of the field. There is, however, such a spirit of contradiction inherent in some minds, that there is probably no discovery which has not been objected to on the ground that it is unnatural or injurious. I suppose there are few who will deny that a certain amount of good has been done by the medical profession; yet there is a class of the community who style themselves, I believe, the peculiar people, one of whose tenets is that it is morally wrong to apply for medical assistance, and that the treatment of disease should consist exclusively in prayer, anointing with oil, and laying on of hands. I remember very well when chloroform was first introduced, that it was strongly objected to on the ground that it was wrong to abolish pain, that in surgical operations pain was beneficial, and that to prevent it would be hazardous to the patient. I wonder if any of these objectors ever showed his sincerity by declining on these grounds to take chloroform when he was having a tooth extracted, or a whitlow opened.

Another argument brought forward against vaccination is that it is dangerous, that it is the cause of skin diseases, and that in many cases it is even the direct cause of death. Scrofula and consumption are cited as amongst the chief diseases which may be directly transmitted to healthy children by means of vaccine lymph. If, however, due caution be used in vaccinating, if the operation be not performed upon too young, feeble, or sickly children, not during the time of teething, nor at very unfavourable seasons, the bad results will be found to be so extremely

rare, that in comparison with the advantages attained, they will appear of trivial importance. Of course when I speak of vaccination, I suppose it to have been carried out in the best manner, for there can be no doubt that bad results may follow when the operation has been carelessly performed. This leads me to say a few words regarding the precautions to be attended to in the performing of vaccination. Of course I do not enter into particulars which concern the operator; I only make one or two general suggestions.

In the first place, except in very pressing cases, children should only be vaccinated when they are in good health. The existence of any acute or chronic disease, or particularly of any skin affection, will almost certainly interfere with the course of vaccination. No doubt there are circumstances, as when small-pox is epidemic, which may render it imperative to perform the operation, notwithstanding the existence of contra-indications.

In the next place, the child should be vaccinated in early infancy. One-fourth of the total mortality in England from small-pox occurs in children under the age of one year; and hence the great risk of delay. Healthy children living in large towns should be vaccinated when about three months old; in more delicate children it may be postponed for a month or two; but all, except those whose health positively contra-indicates it, should be vaccinated before the age of six months. Finally, the lymph used in vaccinating should be taken from healthy children, from healthy vesicles, and a sufficient number of punctures should be made. As, however, these are points with which every vaccinator is supposed to be familiar, I need not farther insist upon them. I may mention, however, that the various Licensing Bodies now require that every one of their licentiates shall have received special instruction in the performance of vaccination, and shall have obtained a certificate of his competence to perform it.

The last point I have to consider is the protective power of vaccination. It may be stated generally that persons who have once been successfully vaccinated are, as a rule, permanently protected against small-pox. A certain proportion will, however, be liable at some period of their lives to take the disease a second

time, generally in a mild and modified form, though occasionally severe and even fatal cases occur. You are aware that one attack of scarlet fever, measles, or hooping-cough usually protects from a recurrence of these diseases. Exceptions, however, do occur, and every now and then we have instances of second, or very rarely of third, attacks of these diseases. Now vaccination, with its subsequent phenomena, may be looked upon as a very mild attack of small-pox; and it is not surprising that after a certain period the protective influence should sometimes wear out, and susceptibility return, though usually in a very trifling degree. An attack of natural small-pox usually, but not invariably, protects against a recurrence. I remember, when I had charge of the Small-pox Hospital, having a patient with a severe form of the disease, where the pocks of the second attack were actually situated on the pits of the first. As such exceptional cases occur after the natural disease, they occur with still greater frequency after vaccination; and hence arises the question of the propriety of re-vaccination. By many this practice is only considered necessary when there has been some defect in the primary vaccination, as indicated by the imperfect character of the scar or cicatrix; but there can be no doubt that it is very valuable, by extinguishing the renewed susceptibility to small-pox which may gradually arise. I believe it, therefore, to be a very proper precaution that every one should be re-vaccinated between fourteen and sixteen years of age. In a great many it does not "take," as it is called, and this merely indicates that the susceptibility to the disease has not returned; while in a considerable proportion it takes as perfectly, or nearly as perfectly, as in the infant. When re-vaccination has succeeded, it is, I believe, quite unnecessary to repeat it; but if it have not, it may be performed again a few years later, particularly if an epidemic of small-pox has broken out, or if the individual should be about to proceed to a warm climate, which appears to have the effect of increasing the susceptibility.

Were vaccination and re-vaccination properly attended to, small-pox might, as I have already said, be stamped out; but although this very desirable consummation is theoretically possible, I am afraid it will never be arrived at practically. Prejudice, ignorance, and indifference are too formidable enemies to be ever

entirely got the better of, and we must, I fear, be satisfied if we confine the ravages of the disease within the narrowest possible limits

Before concluding, I may be permitted to make a few observations as to what may, in the future, be expected of medicine in the prevention of disease, more particularly of these epidemic diseases which contribute so largely to the annual mortality. Till lately it was considered that the sole duty of the physician was to cure disease, but very erroneous ideas were entertained as to what disease really was. Diseases were formerly looked upon as new and independent entities, but now we look upon them as perversions of natural or physiological processes. Formerly, when an inflammation manifested itself, it was regarded as something superimposed upon the organism; as an enemy attacking the fortress of life, which required to be repulsed by the most energetic measures. Its supplies must be cut off by the enforcement of a rigorous diet, and it must be attacked with the heavy artillery of bleeding, mercury, and blisters. But it was not kept in mind that by these measures the garrison was weakened in an equal degree with the enemy, or rather in a greater degree, so that even if the adversary were overcome or retired from the contest, the patient often succumbed owing rather to the severity of the treatment than to the malignancy of the disease. Now, however, we look upon inflammation and other diseases in a different light; we view them as perversions of normal states, induced by the operation of some external or internal agency. We endeavour, therefore, to put the part or the system in the most favourable circumstances for the resumption of its physiological condition. By the adoption of this rational treatment, a very considerable diminution in the mortality of disease has taken place.

But of late years it has been recognised that the physician has another duty to perform. It is not enough that he interferes when disease has manifested itself; he is called upon to show how it may be prevented from occurring. And it must be borne in mind that this preventive office is even more important than the curative. Disease, when fairly established, is often incurable; or, if the more urgent symptoms are removed, it frequently

leaves behind it a permanent weakness or debility. As there is never a battle in which the conquerors do not suffer more or less severely, there is never an attack of illness which does not leave the body weaker than it found it. It is only lately that the fulfilment of the duty of preventing disease has become partially possible, because it is only lately that any definite knowledge has been obtained regarding the causes of these diseases. Within my own recollection two of the most important fevers, typhus, and typhoid or enteric fever, were confounded together, and of course their causes were unknown. I do not say that even now their causes are thoroughly understood, for there is still a difference of opinion as to whether or not they should be included among the specific diseases. It is, however, now well ascertained that whereas typhus fever is caused by, or at least is closely associated with destitution and the crowding together of human beings, typhoid fever is due to bad drainage and the emanations from decaying excrementitious matter. The physician has proved this, and so far has performed his part; it remains for the sanitary authorities to carry out his suggestions, and to banish these diseases from our midst. Considerable improvements have been effected, so far as typhus is concerned, by piercing new streets through densely populated localities, and by preventing overcrowding in dwelling-houses, but in the case of typhoid fever we cannot say even this. There can be no doubt that bad drainage is worse than no drainage at all, and, unfortunately, our drainage and other sanitary appliances are often defective, both in their design and in their execution. We constantly hear of typhoid fever appearing among the inhabitants of new houses; now this is absolutely unpardonable, as showing that the drainage arrangements have been badly planned, or that their execution has been carelessly carried out. And this state of things will continue until the authorities insist that a strict supervision be exercised on the construction of all new tenements, and that when constructed this supervision be renewed from time to time.

With regard to the more strictly specific diseases, I have, I trust, shown you how vaccination has robbed small-pox of its terrors, and there is strong reason to hope that the same result may be arrived at in the case of measles and scarlet fever. The

poison of these diseases, as in the case of small-pox, doubtless consists of infinitely minute bodies, which float about in the air, and which, when introduced into the bodies of unprotected individuals, lead to the development of these diseases. Now it is in the highest degree probable that we may succeed in rendering these poisons practically innocuous. We are led to believe this by knowing what has already been done in the case of a disease which bears a close analogy to them. There is a very deadly malady to which some of the lower animals are subject, called splenic fever. It has been known for some time that in the blood of animals dying of this disease there are very minute foreign bodies of a vegetable nature which have the power of almost indefinite multiplication. It was then shown that these bodies could be cultivated in fluids outside the body, and that they formed germs which could remain long inactive, but which, under suitable conditions, could grow and multiply. Then followed the brilliant discovery that by cultivation this fungus could be so modified that when innoculated into animals it only produced a mild attack of the disease, but that this protected the animals from subsequent attacks, even when exposed to the poison in its most malignant forms. There can, I think, be little doubt that by means of experiment it will yet be shown that the poison of measles and scarlet fever may be modified in a similar manner, and that, as in the case of small-pox, these diseases may be deprived of the greater part of their malignancy.

In bringing this lecture to a conclusion, I have only a single remark to make. Of late years the advances of medicine have been very rapid in every one of its departments, and everything leads us to believe that they will be still more rapid in the future. We can never expect to get rid of disease altogether, for susceptibility to disease is a law of our nature. It cannot be expected that medicine shall ever take rank with the exact sciences, for where we have to deal with the phenomena of life, vitality introduces a disturbing element, which we can never expect to get the better of; but we may safely look forward to a period when we shall be enabled to undertake a more equal struggle with disease, —a period when the success of the physician shall be more nearly than at present on a level with his good intentions.

A COLD:

What it means; its possible consequences; and how it is to be avoided.

BY JAMES O. AFFLECK, M.D.

MR CHAIRMAN, LADIES, AND GENTLEMEN,—The subject of this evening's lecture was suggested to me by the Committee of the Health Society, and, although left free to make choice of other subjects, I did not feel disposed to depart from their selection, seeing that the topic is one of general concern and much practical importance. It had, besides, this additional recommendation to me, namely, that the manner of handling it was indicated in the terms stated on the programme. I have accordingly undertaken to address you on the subject of A Cold; what it means; its possible consequences; and how it is to be avoided.

Instead of attempting at the outset to define precisely the common expression "a cold," of which most of us already possess some notion derived from personal experience, I shall at once proceed to consider the first part of the subject, viz., WHAT A COLD MEANS, and this will, of course, involve in a general way its definition.

Among the many ideas which we are wont to associate with life, and which vary in accordance with our moods or currents of thought at particular times, whereby we liken it to a journey, a race, a conflict, a dream, &c., there are few more appropriate, or more constantly applicable, than that which views it as a condition of defence or resistance. In point of fact, however, this view is something more than a mere idea, it is an actual attribute of life. It could be easily shewn to be true of life in its social, intellectual, and moral aspects, but it concerns us here to deal

with life in its physical manifestations; and whether we regard these as displayed in plants or in animals, we shall find that there are always in operation processes, which, while serving many other ends, such as growth and nutrition, at the same time effectually secure the organism from the action of hurtful influences, that would, if left to exercise their effects unresisted, infallibly accomplish its destruction. While this general principle is equally true in the case of man, it is to be observed that the conditions of his existence are affected by civilization and by his surroundings, and therefore, that besides these natural processes of defence, he must have recourse to his intelligence to devise additional means for his protection. And yet we know that, notwithstanding all that can be done in this way, the enemy gains but too ready access to him, and works havoc in his frame, nay, that even many things calculated to minister to his comfort and well being, become under certain circumstances the means of his hurt or even of his ruin. Among the agencies of this kind which may be productive of good or of evil, there are few of such consequence as the atmosphere in which man lives and breathes. Who does not feel how much of health and comfort depends on the state of that element? Its purity is essential to respiration, and on its condition as to temperature hang important issues of life. Now it is with the relation of our bodies to the temperature of the atmosphere, and with its influence upon them, that we have at this time specially to do; but before we proceed further in the discussion of this subject, we must consider for a little in what way our physical frames are acted on by the coldness or warmth of the surrounding air. This again will render necessary my making, in the first place, some general remarks upon the subject of the sources of that animal heat which all of us who are in health feel we possess. This heat, then, is derived not from without, but from within our bodies, where it is generated as one of the results of changes which are constantly going on in the processes of nutrition—in the wasting and building up again of our tissues. Every organ or member of the body in the performance of its function expends part of its substance—it wastes—but if the body be in health, and due nutriment supplied, this is immedi-

ately repaired; and in this process, which is very much a process of combustion, heat to a greater or less amount is generated. This statement is true in an especial manner of our muscular system, the part of our structure which is most universally and constantly in a state of activity. Thus the generation of heat is one of the necessary properties and accompaniments of animal life—inseparable from it; and when life ceases the animal heat departs and cannot be revived. You cannot warm a dead body any more than you can reanimate it.

But the heat thus generated does not in health accumulate within us,* but is always being given off from our bodies in various ways. Thus part of it is given off by the lungs, for the air we breathe out is warmed by it; part of it is given off by the skin, from which it radiates into the surrounding atmosphere, or is conducted away by cooler bodies, or is given out in the form of perspiration. Besides this, others of the natural channels of the body carry away a certain amount. It is thus evident that in the living body there is a manufacture and an expenditure of heat constantly going on. Notwithstanding this the heat of our bodies in health is a tolerably uniform quantity (98°—99° F.) whatever be the temperature of the surrounding atmosphere, and any material deviation from this betokens some departure from health. It might interest you to hear of the extremes of temperature which the human body can bear with impunity. As regards cold, the experience of Arctic voyagers is remarkable. Thus Capt. Sir John Franklin recorded a cold of -58 or 90° below freezing point; Capt. Back, -70 or 102° below freezing point; and more recently Capt. Sir George Nares, in his interesting account of his voyage to the Polar Seas, describes his experience, in March 1876, of the extraordinary temperature of 73·75 or more than 105° below freezing point. It is difficult for us, even with the experience of our most severe winters, to conceive of this amount of cold. Capt. Nares states that the very "whisky froze hard, and a few of us had the rare opportunity of eating it in a solid state." The

* It has been estimated that if this heat were allowed to accumulate within us, and none to be given off, it would be sufficient to raise the body to the boiling point in thirty-six hours.

health of the crews kept good even in this terrible cold. "Fortunately," adds Capt. Nares, "these extremely low temperatures never occur with a high wind, or no human being could possibly endure the weather." As regards heat, in many parts of the tropics, there is a daily temperature of considerably over 100° F., but a much greater amount than this can be borne for a limited time without injury. Experiments were made on the subject about a century ago by Drs Fordyce and Blagden, who found they could remain for a considerable time in a chamber heated to 260°, and it is well known that certain workmen, such as those in sculptors' foundries, have to go into chambers where the floor is red hot and the air heated to 300° or 400°. If we bear in mind that in such extremes alike of cold and heat, the temperature of the body remains unaltered to any appreciable extent from its natural standard (98°—99°) it follows that there must be some defensive power or arrangement possessed by our bodies which enables them to withstand the evil effects we should naturally expect to arise; in short, that there must be some means or adjustment for regulating our bodily temperature and keeping it at a uniform point. And such an arrangement does exist, and is in fact simply that process of the giving off of heat to which I have already referred. We saw that every muscular effort implies an increased waste of tissue, and therefore an increased production of heat. When we exercise our muscles vigorously, such as in active walking movements or manual labour, and thus generate much heat within us, how is it that we get rid of the overplus above the normal amount? Chiefly by the lungs and skin. The very activity makes us breathe faster, and therefore more heat passes away from us in this manner, while at the same time the blood is driven to the surface of the body and circulates in increased amount in the skin, which thus becomes the agency, by the processes of radiation, conduction, and perspiration, of drawing off a very large amount of warmth. In this way the increase and loss of heat are equalised. Again in the case of the action on our bodies of extreme cold the same result is brought about, as we shall afterwards see, by a sort of reverse process. We shall also find that the nervous system is largely concerned in controlling all these

natural operations. Now these statements regarding the heat regulation of our bodies, and the chief factors concerned therein, are of the utmost importance in relation to the subject in hand, for it is by some disturbance in this physiological equilibrium, if I may so express it, that the morbid effects of cold are induced.

Let us then inquire for a moment what are the effects on the body of cold when it is left free to exercise its hurtful action. The tendency of extreme cold is to the depression of all the vital functions, an effect which it exerts apparently through the agency of the nervous system. Death from exposure to cold is happily a comparatively rare occurrence in this country, and yet never a winter passes without some instances of it. In the severe winter of last year the number of deaths from this cause was exceptionally large all over the kingdom. In such cases the sufferer, after prolonged exposure, in which much animal heat is lost, sinks into a lethargic state, in which the functions of respiration and circulation speedily cease, the fatal event being hastened if the person has been long without food, or is in a state of intoxication. The effects of cold on the functions of the nervous system were never more strikingly displayed than among the soldiers of the First Napoleon in the disastrous retreat from Moscow in 1812, when we are told some of them became mad, many were seized with convulsions, others staggered about as if intoxicated, and sank into a stupor from which they could not be aroused.

Short of such extreme results, other evils, essentially the same in nature, though differing in degree and in their subsequent effects, are capable of being produced by cold. These may be either local, or general in the system. As an illustration of the former, there is the condition known as frost-bite, of which the familiar chilblain is but a mild form. Here, some exposed part of the body is subjected to the action of extreme cold; it becomes pale and dead looking, and unless the circulation be quickly restored, does actually perish by a destructive process of inflammation. The cold has altered the normal nutrition of the part, has lowered its vitality, to such an extent as to cause this inflammation to arise in and around it. This may be considered a direct local effect. But apart from this, and far more frequently,

there are other effects which are to be regarded as secondary consequences of the depressing action of the cold on the general system, particularly the nervous system, and which are shown in lowered vitality and subsequent inflammatory action in some part or organ. Let me explain. The nutrition of every portion of the body, to the most minute tissue, is under the direct influence and control of the nervous system, as is proved by the fact that anything which interrupts or interferes with the communication between a part and its nervous connections, will affect the health or soundness of that part. I cannot at present stop to inquire how this nervous influence is exercised, but you may just bear the fact in mind. The nervous system, which, as you know, embraces the brain, spinal cord, sympathetic, &c., and the numberless branches of nerves which ramify everywhere throughout the body, and in no place more abundantly than in the skin, is so arranged that an impression made at one point, and conveyed from thence to the spinal cord or brain, may there excite either the same or else a new set of impressions or actions, which may be conducted to another and far distant point. It is in some respects like the very useful system now in operation of what is called the "telephonic exchange." A number of individuals have telephonic wires leading from their houses or places of business to a common central office. If then A, living in the west end, wishes to communicate with B, living in Leith, he cannot do so directly, but he sends a message to the central office to say, "put me in communication with B," whereupon his wire is switched on to connection with B's wire, and the two can then converse with each other. Now to apply this to the subject in hand, an impression of a depressing kind is made upon some part of the surface of the body, say the feet, the chest, or neck, by cold or damp. It is conveyed to the brain, which sends it off again, not necessarily to the part or organ from whence it came, but to some other one altogether. The message the brain sends is that for the time the healthy nutrition of the part is to be altered or disturbed, and, as a consequence, some mischief, generally in the form of an inflammation, more or less severe, must result. This, I take it, is very much what happens when we catch a cold.

What determines the locality of the body where the effect is to appear is beyond our power to explain. Why, for example, it should happen that of three persons exposed to the same amount of cold, one should take a rheumatic fever, another a simple cold in the head, and the third perhaps be entirely unaffected, we cannot positively say. It may be, however, that in each individual there are certain parts and tissues of the body which, from constitutional causes, inherited or otherwise, or from previous diseased action in them, are more vulnerable than others. We know that there are parts which, from their situation, their functions, or their relations to other organs (such as the relation of the lungs and the kidneys to the skin), are easily excited to inflammatory action, as the result of a chill to the surface of the body.

These points, then, enable us to settle the question what the term " a cold " means. It means, or rather ought to be understood as meaning, an inflammation of some portion of the body brought about by the direct or indirect action of a lowered temperature. Popularly, of course, the term has a more restricted meaning, and is generally used in reference to an irritation of the respiratory passages, or, as it is technically called, a catarrh, about which I have something to say under the second division of my subject.

Meanwhile, having tried to show what the *nature* of the process is, it may be useful to consider for a moment *how we take cold.* It may be stated generally that we take a cold by some cause which makes us part too suddenly and too abundantly with our natural animal heat, in fact by our becoming chilled. While we are in health our bodies may, as we have seen, sustain cold of extreme degrees unhurt, but even then certain conditions are necessary, such as that food be sufficiently supplied, that exercise be taken, and that adequate protection by clothing be afforded—conditions, however, which when observed, not only enable us to bear cold with impunity, but cause it to excite in us that pleasant glow which proves it to be a source of strength and exhilaration.

But let these conditions be wanting, and then the case is totally altered. If our health be depressed from any cause, or if we have had insufficient food, we feel the cold air take hold on us in a way that is the reverse of comfortable. Or again, if we are long

exposed to a low temperature, and are compelled to remain in a state of inaction, we quickly lose our animal heat, and are unable to replace it in adequate measure, and so become more or less thoroughly chilled. Thus it is that we suffer when in cold weather we sit in rooms without fires, or go into places of resort which happen to be imperfectly heated. Our heat is radiated away into the cooler air around, and we readily catch a cold. All the more surely will this take place if our clothing be thin, or of such a kind as offers but a feeble impediment to this heat radiation. Sudden alternations of temperature too, such as in leaving a warm apartment and facing a cold wind, particularly if the body be perspiring, produce a like result, by disturbing the natural heat-equilibrium already described. Further, when cold is accompanied with moisture its chilling effect upon the surface is intensified, and we all know that there is no more certain way of catching a cold than by exposure to a damp atmosphere of low temperature, or by getting wet through. It should ever be borne in mind that the power of resisting cold even in health is much less at the extremes of life than at any other period, and that therefore children and old persons alike part with their animal heat and suffer from the effects of this in a very marked degree.

It is evident, then, that it is in most instances by impressions made upon our skin that we take cold. This wonderful vesture of our bodies is not only, as has already been told you in previous lectures, of prime importance as an organ of elimination of waste matters, but it is equally so as a medium of conduction in relation to the temperature within our systems and that outside of us. It is not a good conductor, and well for us that it is not, otherwise we should be liable to be hurt far oftener and far worse than we are. This comparatively negative power as regards conduction it is that in great measure prevents our suffering from the sudden and frequent changes in the temperature of the air around us, as it no less prevents our losing too quickly or too abundantly the heat within us. But in addition to this, we possess in the function of the skin, if it be in health, an arrangement which may be regarded as constituting our

first line of defence against the hurtful influence of extremes of temperature. No sooner does a cold blast impinge upon us than the skin, richly provided as you already know, with bloodvessels and nerves, contracts, and we often observe the surface roughened with little points in consequence of this contraction. In thus contracting its bloodvessels become emptied of their blood, and its heat-radiating and evaporating function is for the time arrested, while the body goes on accumulating heat sufficient to furnish a reaction when the cold is withdrawn, or before it. This reaction or glow is one of the best indications that we have not been injured by the cold. But this salutary process operates within comparatively narrow limits, and is conditioned by so many circumstances, that it too often proves inoperative. Thus it may happen that the vitality of the skin is weak from natural delicacy, or from neglect to maintain it in a healthy condition, and so it will fail to contract vigorously or remain contracted till a glow can be established in time to prevent mischief, and the same thing will happen even in a healthy skin, if the cold be too severe and too long continued. The result of this will be a too rapid withdrawal of heat from within, and an impression made upon the nervous system which will be transmitted to some part or organ, and produce in it the morbid effect of cold, viz., inflammation. It would seem, however, in such instances that before matters proceed to this extent there is often an effort of nature to keep the enemy, which has now got within the lines, from advancing to the citadel. What, for example, causes us to shiver when we leave our homes and go out into the cold air of a winter night, or what is the meaning of our sneezing vigorously when exposed to a cold draught? It would seem probable that these acts stimulate the depressed nervous system to increased resisting power, and in this way tend to ward off the full effect of the action of cold. Moreover they in a peremptory way call our attention to the matter, and lead us to join the efforts of our will in keeping off the enemy. The statement that "the man who resolves not to take a cold seldom does," * although it may seem to you a strong one has nevertheless much

* *Lancet*, 29th November 1879.

truth in it, for not only does he brace himself up to exert a strong mental resistance when he feels himself threatened, but he almost instinctively resorts to some physical means to prevent his being chilled, and to bring himself aglow, such as by quickening his pace, or other vigorous and steady movement, and in this, if he be in health, he will generally succeed. Some of you may remember the graphic description by Cowper in the "Task" of the country labourer driving home his team in a stormy winter evening:—

> "He, formed to bear
> The pelting brunt of the tempestuous night,
> With half shut eyes, and puckered cheeks, and teeth
> Presented bare against the storm, plods on.
> *　　*　　*　　*
> O happy ! and in my account, denied
> That sensibility of pain with which
> Refinement is endued, thrice happy thou !
> Thy frame, robust and hardy, feels indeed
> The piercing cold, but feels it unimpaired.
> The learn'd finger never need explore
> Thy vig'rous pulse ; and the unhealthful east
> That breathes the spleen, and searches every bone
> Of the infirm, is wholesome air to thee."

Unhappily, however, we are not all made of such stout material, and in our modern ways of living any of us—even the strongest—may catch a cold, whether we resolve or no. Indeed it would seem that many of our colds come upon us by stealth, and we are often unable to say how we have contracted them. I must now, however, leave this the first part of our subject, but before doing so let me in a word summarise the points I desire you to bear in mind respecting the nature of a cold.

1. That our bodily heat depends not on clothing nor on anything external to us, but upon active changes going on within us in the processes of nutrition.

2. That during life this heat-generation is always going on, while at the same time there is a giving off of heat from our bodies, chiefly by the lungs and skin, and that the due adjustment of this heat-production and heat-discharge maintains the

body at its normal standard of temperature, 98°—99° F., irrespective of that of the surrounding air.

3. That extreme cold by removing our bodily heat tends to exercise a depressing effect upon our nervous system, but that in health this effect is resisted up to a certain point by the protection afforded by clothing, but more especially by the defensive and reacting power of our skin.

4. That when this defence is broken down, either by too prolonged exposure, ill health, want of food, insufficient clothing, &c., a morbid impression is made upon our nerves and brain, which is conveyed from thence to some part or organ of the body, and produces an alteration in its nutrition, which finds expression in the form of inflammation either slight, as in the case of a simple catarrh, or of more grave and serious character; and that all this is included in the term "a cold."

II. We have now to consider the second part of our subject, viz., THE POSSIBLE CONSEQUENCES OF A COLD. It will, I think, be obvious even to those possessing no medical knowledge at all, that this expression cannot be taken in a literal sense, for in disease, as in everything else, the contemplation of possibilities might exercise our minds for a whole lifetime. I must therefore limit myself to a reference to the chief possible consequences of the taking of a cold as these are ordinarily presented to medical experience, and even this restricted view will not, in the time at our disposal, admit of anything beyond the most general remark.

It may be said with truth that there is no disease to which the human body is liable that may not be seriously influenced by the effects of cold, but while this is true it is also the case that certain ailments are affected in a very special manner by this cause, while many others undoubtedly owe their origin to it. The catching of a cold will not indeed bring on any of the specific fevers such as scarlet, typhus, or typhoid, or the other so called "zymotic" or infectious maladies, each of which is primarily due to the reception into the system of a particular disease-poison or germ. But while this is the case it is no less true that the taking of a cold exercises a very important influence in relation to this class of ailments. Thus it will by its depressing action render

us more liable to receive the contagion of them if we are thrown in the way of it. But this influence of cold is shown chiefly by the extent to which it aggravates the severity, and increases the mortality, of almost all those complaints I have mentioned, by inducing complications and results which are often far more serious than the original disease. This is strikingly the case as regards the infectious diseases of childhood, such as measles, hooping cough, and scarlet fever. Simple enough ailments in themselves in the vast majority of cases, they become, chiefly by reason of their complications (which are principally inflammatory affections of the lungs or kidneys), the causes of a terrible destruction of infant life, and are justly looked upon as the scourges of our families. These complications no doubt belong to, or form part of, the disease, and may appear despite the greatest care; but it is unquestionable that in a large proportion of instances they are justly to be ascribed to the influence of cold, the tables of mortality of the Registrar-General showing how largely the death-rate from these diseases is increased in the colder months of the year, or when the temperature is low. I may be allowed to add my own confirmation of this, as the result of observations in the Fever Wards of the Royal Infirmary for a number of years past. But the evil is not to be measured alone by the extent of the mortality, for such complications, even if recovered from, but too often lay the foundation for future bad health, and careful medical enquiry can often trace back some disease occurring in later life to its origin in connection with one of the disorders of childhood. This is a fact which parents and those in charge of children would do well to ponder, and the practical lesson it conveys as to the exercise of the utmost care and watchfulness needs no enforcing.

Rheumatism is another malady upon which the influence of cold is exhibited in a marked degree. Doubtless a rheumatic constitution is in many persons an unfortunate inheritance, but whether connected with this or not, the acute form of the disease, that which goes by the name of rheumatic fever, is in almost all instances traceable to a chill of the surface of the body produced by getting wet through, by long exposure to a cold wind, or by

sudden arrest by cold of perspiration. This painful complaint is a common ailment of early life, particularly in our climate, and is ever to be looked upon as a serious one, not so much from any immediate danger (though even that is not inconsiderable) as from its tendency to induce disease of the heart. Every physician knows how large is the number of cases of heart disease that owe their origin to acute rheumatism in youth, brought on as the result of a cold, and it is sad to reflect how much suffering and death are thus due to causes in great measure preventible. But not alone in its relation to heart disease is the evil effect of rheumatisms made evident. The disease once occurring tends to return, and to bring about alterations in the joints which render many a strong man stiff and infirm long before his time, to say nothing of aches and pains which afflict him on every change in the weather, and add so seriously to the burden of life.

On no part of the human body does cold tell with more severe and deadly effect than upon the organs of respiration. The deaths in this country from diseases affecting these organs far outnumber those from any other class of ailments.* The respiratory tract commences at the nostrils, extends back into the throat, down into the windpipe, then into the bronchial tubes, which lead into the lungs, which latter organs are invested by a thin delicate membrane called the pleura. The inner passage, that is from the nostrils to the lungs, is lined throughout with a thin membrane called the mucous membrane. It is easily excited to inflammation, and is the part which suffers most when we take a cold in the head or chest. It is not, however, by breathing in cold air,

* This in Scotland in the year 1877 (according to the most recent annual report of the Registrar-General), out of the total number of deaths, viz., ... 73,937

The deaths from diseases of the respiratory organs (chiefly bronchitis and inflammation of the lungs) numbered	14,249	
And from consumption alone	8,342	
	22,591	

Or 1 out of about 3·3 deaths is due to diseases affecting the respiratory organs

over this membrane if it be in a healthy state, that we catch a cold, but in the way I have already tried to explain, by a chill to the surface of the skin making an impression on its nerves, which is conveyed to the brain, and from thence reflected back upon, or telephoned to, some other part. Now it appears to be this very part that is in most frequent telephonic communication with the brain upon the subject of a cold, partly no doubt from its exposure to vicissitudes of temperature rendering it more susceptible, but no doubt also from its intimate physiological relationship to the skin.

Let us look for a moment at the effects of a cold on the various parts of this respiratory tract, bearing in mind that usually only a portion of it is affected at one time, although it may spread on to another part. The effect is, as I have already stated, to produce an inflammation of the mucous membrane, which causes at first swelling and then some discharge from the surface, both of which will impede more or less the free passage of air into and out of the lungs, and affect the breathing according to the part of the tract where the disease is located. Thus when it is confined to the first part, viz., the nose, we experience those symptoms characterising a cold in the head, with which we are all familiar, and which, though very unpleasant, particularly on lying down, does not seriously interfere with breathing, since we have in the mouth a supplementary channel for the entrance and exit of our breath. But let us pass a little further on, say into the windpipe, and here the effect of a cold is a very much more serious affair. At this part the channel for the passage of air is very narrow, and there is no supplementary one, so that when it becomes narrower by swelling, or inflammatory deposits on its surface, a formidable mechanical impediment is presented to the breathing, and there is risk of suffocation. This is the state of things in croup, and constitutes the danger of this malady. Let us now inquire how a cold affects the branches of this windpipe, or the bronchial tubes as they are called, the channels leading directly into the lungs. You will notice that these tubes differ in size, being larger as they pass off from the trunk, *i.e.*, the windpipe, and smaller as they branch away towards the lungs, the ultimate ones being exceed-

ingly minute, and ending in the air cells of the lungs, where they convey the pure air breathed in to the blood, which requires this for carrying on the functions of life. Well, when inflammation attacks these bronchial tubes there is produced that common disease (one of the most common) bronchitis. This is one of the most serious of complaints, and its gravity depends on the extent to which the inflammation spreads throughout this bronchial tree, whether both sides are affected, and whether it involves the larger or the smaller branches. There is always more or less obstruction to breathing in bronchitis, as well as cough and expectoration, and general illness; but more particularly is this the case when the disease is located in the smaller branches. This is the form it is apt to assume in young children, and a very fatal form it is. Thus in Scotland in 1877, of the total number of deaths from bronchitis, viz., 9182, no fewer than 4305 occurred in children under three years of age. It is also extremely fatal to old persons. But apart from its fatal effects, bronchitis is liable to recur and become chronic, leading to changes affecting both lungs and heart, which occasion prolonged bad health, and ultimately terminate life. More deaths occur in this country from bronchitis than from any one disease, and bronchitis, bear in mind, usually begins by a simple cold. But again, a cold may attack the lungs themselves and produce inflammation in them, or acute pneumonia, or, as it is now often but erroneously termed, congestion of the lungs. The effect is to produce a hardening or solidifying of their natural spongy texture, and to cause great embarrassment of breathing. This is always a serious malady, but if uncomplicated and in a previously healthy and temperate person, usually runs a favourable course. Then, either along with pneumonia, or apart from it, the outer covering of the lung—the pleura—is often excited to inflammation by cold and damp, and that painful complaint pleurisy is the result. In severe cases of this disease an effusion of fluid collects outside the lung and compresses it, rendering it unable to expand to admit air in breathing, and unless this fluid be drawn off or otherwise removed by treatment, imperilling life or entailing serious permanent consequences to the lung and function of respiration.

But beyond all those ailments I have named, in importance is the relation of cold to the production of pulmonary consumption. This disease derives, as you know, its melancholy interest from the fact that it marks specially out as its victims those who, having passed out of childhood's dawn, are in "life's gay morn," with its bright future of promise and anticipation, when the very idea of suffering and dying is, and ought to be, as unwelcome as it is unnatural. How often has the fire of Genius been quenched by the rude blast of this Angel of Death, while as yet it was scarce aglow, and all that survived to a sorrowing age were some treasured fragments of a brief life's work—a sad but imperishable witness to greatness, the beginnings only of which could be achieved, and to virtue that had blossomed but to die! Who among us has not lost a friend, or it may, alas! be one dearer to us than friend, by this dire malady. Have we not often known it devastate a family; removing one, and another, and another, till all were gone. Is it not in every sense of the word truly named consumption?

Now that this malady shows a tendency to run in families is admitted on all hands; but such hereditary influence has probably been greatly overrated, for assuredly in large numbers of instances it cannot be established, and in them the disease must be regarded as acquired. It does not now concern us what is the proportion between these two categories. It is sufficient to know that apart altogether from any hereditary predisposition, consumption may show itself in any one,—in the strong, well-built, and hardy, no less than in the feeble, narrow-chested, and ill-developed. It would lead me too far into the field of purely medical discussion were I to bring under notice all the different factors concerned in the production of consumption, but it may be safely affirmed that in a very large proportion of all forms of this disease one of the principal of these is the taking of a cold or a series of colds. The history of many a sad case of this kind is often very much the following:—A young man (the same quite as often happens in the case of a young girl) catches a cold, to which perhaps he is rather liable. He thinks little about it, and it does not give him much trouble, except that he coughs

occasionally, particularly on lying down at night, and on rising in the morning. He does not look very ill, or it may be is even congratulated on looking fresh and ruddy. But the cough still goes on, for weeks, or it may be for months, and he is at length noticed to be getting thinner. His friends, feeling some uneasiness, persuade him, rather against his will, to seek medical advice. Then is brought to light the real state of matters, and it is found that already he is in the grasp of this dread disease. Who so truly as the physician can realise and appreciate the pathetic language of Henry Kirke White, himself a sufferer from it, in addressing this "most fatal of Pandora's train."

> "Oft I've beheld thee in the glow of youth,
> Hid 'neath the blushing roses which there bloom'd,
> And dropt a tear, for then thy cankering tooth
> I knew would never stay till, all consum'd,
> In the cold vault of death he were entomb'd."

Now it is in the commencing stage of this disease, while as yet it has many of the characters of a common cold, producing a form of inflammation of the lung, that much may be done by treatment to arrest and remove it, and it is unhappily just in this very stage that it is so apt to be disregarded, upon which there follow the too common results in the wasting of the lungs and the break-down of the whole system. I am far from asserting that this disease, consumption, is not amenable to treatment, and even in a sense to cure, in all but its very latest stages, and our resources are far more abundant and more potent for this than they were when Kirke White wrote; but certain it is that the chance for life and for recovery is immensely greater the earlier the set-down cold is recognised and dealt with. I do not wish to dilate upon this painful topic, except to say that it is from this disease, beyond all others, that the admonition comes with solemn emphasis, *Do not neglect a common cold.*

Disorders of many other parts of the body might be easily cited as owing their origin to cold. Many of the more common and some of the most dangerous of the diseases of the digestive organs (stomach, bowels, &c.) are induced by this cause, as well as inflammatory affections of the kidneys. We know too that many

diseases affecting the special senses, such as sight and hearing, are brought about in this way. But there is one class of ailments which of late years has engaged in a very special manner the attention of medical men, viz., diseases of the nervous system, embracing a large number of most important ailments, many of which are traceable more or less directly to the effects of exposure to cold; for as I have stated in a previous part of this lecture, the influence of a low temperature on this portion of the human economy is very marked. Many forms of neuralgia, which cause intense and oft-recurring suffering, are excited by this cause, and may sometimes be completely cured by an alteration in the mode of dress, which affords greater protection to the affected part. Paralysis, too, may be brought about by cold, a not uncommon form being that affecting one side of the face after sitting with it exposed to a draught of cold, which arrests the function of the nerve supplying the muscles of the face, and thus for a time paralyses them. But more serious forms of paralysis may result from cold. Thus I had recently under my charge for a time in the Royal Infirmary a strong young man who had entirely lost the power of both legs by paralysis, which was caused, beyond all manner of doubt, by his having got thoroughly wet, and gone about for hours without having a change of clothing. Other examples of nervous disease connected with exposure to the action of cold might easily be narrated. But time would wholly fail me were this part of the subject to be pursued further; and it does not indeed appear necessary to add more to a catalogue of maladies already both lengthy and grim, to illustrate the point laid down, viz., the possible consequences of a cold. It is altogether rather a sombre subject, and must, I fear, have had a somewhat depressing effect upon my audience; yet it is doubtful whether a regard to honesty in dealing with it could have imparted much brightness to facts which are but too often forced upon the observation of the physician, and which, as here recounted, do not err on the side of overstatement. I trust, however, nobody is the worse for what has been said.

The best and most hopeful part of my subject now remains to be briefly considered, viz., HOW A COLD IS TO BE AVOIDED. This is

the conclusion of the whole matter, or its practical application. Time, however, forbids my dwelling on many points of detail that might profitably have been brought under notice. It would be mere presumption in any one to profess to indicate any specific plan which would infallibly secure against the taking of a cold. As long as humanity and its environments are what they are, colds will never cease from among the diseases of men. All that I or any one else could undertake is to furnish you with some general directions, the observance of which will go far towards diminishing the liability to suffer from this cause. I must at the outset lay down one or two principles which, although they may seem mere truisms, are, I venture to think, not always fully borne in mind, or given effect to. The first is, that health, to be preserved, must be looked after; and that not only when it threatens to give way, but when it is at its best, in fact at all times. No man can expect his business to thrive unless he attends to it systematically, and just as little has any man or woman a right to expect the business of their health to thrive unless they give it their attention. I do not say *all* their attention—that is valetudinarianism, and is either a disease or a sin—but their systematic attention, which is a very different thing. This is not difficult of accomplishment, and falls easily in with the general habits of life. Nevertheless there are few of us who do not err in this matter. We complain that these bodies of ours occasion us many of the sorest troubles and burdens of life, but how much fewer of both might there be were we kinder to them than we are—were we indeed only to give them fair play. It is truly surprising how long-suffering they are, and how often it is only after prolonged neglect and outrage that they, as it were, turn upon us and take a severe but not unmerited revenge. That the domain of Christian duty includes the care and the honouring of the body admits of no dispute.

If these remarks be true as regards health generally, how much more are they applicable in reference to those particular points of it which, from our surroundings, are pressed upon our attention, such for example as the influence upon us of a changeable, and often cold and ungenial, atmosphere. How necessary is it to be

protected and armed at every assailable part, and how inevitably must laxity in this matter sooner or later bring its own punishment. I have told you how our bodily heat is generated by changes taking place within us in the processes of nutrition, and how necessary it is that this function be maintained in integrity if we are to escape the evil effects of cold acting on us from without. We must keep this internal fire burning by supplying it with coals, that is with food, and the supply should be regular and of good quality. Don't let it get low by too long fasts, and don't put rubbish in it which will not give any heat. Our food, as previous lecturers have shewn you, must contain a due proportion of the albuminous elements, and of the carbo-hydrates (starch, sugar, and fat). Both are necessary to the heat-generating process. Everyone knows how vigorously we can set ourselves to face a cold wind, when, with a healthy appetite, we have taken a wholesome meal, and if our meal be wholesome, in accordance with the principles I have just indicated, we need nothing more. This leads me to say a word on the effect of alcoholic stimulants as means for resisting cold. The popular idea, and too prevalent practice, of taking a glass of spirits to keep out the cold is a great and dangerous delusion. It does the very reverse. The immediate effect no doubt is to impart a sort of warm glow and exhilaration, but this is a feeling and not a reality. The nervous system is abnormally stimulated, and the action of the heart excited, but these are speedily followed by depression. Again the bloodvessels of the skin are fuller of blood, and in consequence more heat is radiated away from the surface, while the contractile power already referred to as residing in the skin is also impaired, and in these various ways cold is able to exert its hurtful action, while the means for resisting it are greatly lessened by the alcohol.

In this matter the experience of Arctic voyagers and others who have had the opportunity of fully testing it is in entire agreement with the teachings of physiology. Dr Hayes, the celebrated American Arctic explorer, declared that alcohol taken for the purpose of resisting cold was "not only completely useless, but positively injurious;" while the experience of the officers who

accompanied the Red River Expedition, under Sir Garnet Wolseley in 1870, was that while the troops had as arduous work to perform as ever fell to the lot of British soldiers, they continued throughout in excellent health although not a drop of drink was given, the only beverage being tea. Numerous other instances of a like kind could be cited did time permit. Depend upon it, then, that the man who by a single glass of spirits places himself under the influence of alcohol—in a scientific, if not in a conventional sense—is far more liable to suffer from cold than he who has fortified himself simply by sufficient and suitable food. In cold weather the food should be greater in quantity than at other times—this is indicated by our increased appetites—but it should likewise have more fatty matter contained in it, to promote the heat-making process within us. This is especially necessary in the case of the young and the delicate as a means, and a very valuable one, for resisting the action of external cold. Such articles of food as cocoa, milk, bread and butter, may be taken by most persons, even by those who cannot, or will not, eat meat containing fat. The value of a daily small dose of cod liver oil for those, whether young or old, who shew a liability to suffer from colds is very marked. This substance is a food as well as a medicine, and possesses properties which render it easy of digestion, if rightly administered as to time and quantity. It should be taken either after a meal, or near bedtime—probably the latter answers best on the whole; while the quantity need not be large, a single teaspoonful or little more being quite enough. Many a cold, and many a serious and fatal illness might be averted were this practice carried out systematically during a winter, particularly among children.

Attention to the skin is of the very first importance as a measure for enabling us to withstand the injurious effects of cold. It is, as has been already stated, chiefly by the skin that we catch a cold, and it is certainly by the skin that we may most successfully prevent a cold. The relation of the skin to the general health has been amply demonstrated to you in a previous lecture, and I can say nothing to emphasize the wholesome lessons therein conveyed. It is with the care of the skin in connection with the

catching of a cold that we have at present to do, and there are two aspects in which this subject is to be considered. The one is the maintenance in its vigour of the function of the skin, and the other the due covering and protection of the skin. As to the first, bear in mind the facts already brought before you in reference to the structure of the skin, and to its various functions; how it is to be regarded not merely as a covering for the body, but as an organ of the body, consisting of fibrous tissue, cells, glands for sweat and oil, also innumerable bloodvessels and nerves; and possessing in addition to the property of carrying off effete matter, the power of regulating to a large extent the bodily heat. To fulfil all these important offices aright it must not only be unclogged of the matters that are apt to accumulate on it, that is, dirt, and kept thoroughly clean, but also be preserved in a state of good tone, and readiness to act, as we know it is often called upon to act, suddenly, on its defence and the defence of the system generally, when subjected to the assault of cold air. The regular practice of washing and bathing are essential for both of these purposes. It might seem almost impertinent for me to advocate the obvious and natural duty of washing and cleansing the skin, but frequent medical examination of the persons of individuals, particularly in hospital practice, too often reveals a state of things which shews that this advice is not by any means uncalled for. There seems to be a tendency—there is no doubt a temptation—to limit the ablutionary efforts to those parts that are exposed to view, while Nature is compounded with on very easy terms indeed for the rest, to the manifest injury of the health, no less than to the disgust of the unfortunate medical examiner. I say to the injury of health, for if you will recall what was stated as to the number of pores on the surface of the body (about 2,300,000), you will easily understand that if the most of these are closed up by dirt, the whole system must suffer, and the skin itself be enfeebled in function, and less resistant to cold. But in addition to the purposes of cleansing the skin, washing and bathing the body are very important as tonics for the skin, that is, for keeping it in vigorous operation. The genial glow

and pleasurable lightness both of body and mind which follow the cold bath and brisk rub down with a rough towel, would be recompense enough for the effort of self-denial or compulsion, which, on a cold morning, has to be put forth in undertaking it; but there is far more in it than this. For this plan of treatment of the skin, if systematically carried out, induces a healthy action in each single part of its structure—cells, fibres, nerves, vessels, &c., and confers on the whole a vigour of tone which, if it does not afford complete immunity from catching a cold, goes far towards it, since the surface is seldom surprised by any sudden change of temperature, and reacts powerfully when it is. The bath should, if possible, be of cold water, but no absolute rule should be laid down on this point, much depending on the power of reaction, and the presence or absence of the feeling of glow which follows it. There are some persons to whom the cold bath is intolerable, some to whom it is positively dangerous. Very young children, delicate persons, and those advanced in life, should not as a rule have the bath cold, at all events in winter, but the temperature of the water should be raised so that shock may be avoided. In any case, the subsequent thorough rubbing with a rough towel is of scarcely inferior importance to the bath itself. There can be little doubt that were the bath with friction of the skin regularly employed by those up in years—and the habit, if acquired, can be easily carried on—much suffering and disablement from bronchitis or winter coughs might be avoided, as well as many of those troublesome forms of skin disease so often met with. As a means for preventing colds the bath is only of use if employed frequently, daily if that can be, if not, then as often as possible, and with regularity. We are all too well aware that the carrying out of this practice in a large proportion of our smaller houses is in great measure prevented by the absence of the means, viz., the bath, and even the most zealous in this cause has often to be content with an unsatisfactory substitute in the shape of a daily rub down with a wet towel or sponge. The obvious remedy for this, and a most desirable sanitary measure, is the establishment of public baths on a sufficiently large scale. It was a welcome announcement which was

made here the other night by the Convener of the Health Committee of the Town Council, viz., that this matter was engaging the attention of that Committee, and of the Medical Officer of Health for the City, and we may be sure that in such energetic hands it will not be allowed to rest. Such a public blessing cannot come a day too soon—as blessing I feel sure it would be regarded by the working people of Edinburgh.

The next point as regards the skin is its covering. Our skin, however healthy, must be protected by clothing, which will prevent the too great access of external cold on the one hand, and the too abundant radiation of heat from the surface of the body on the other—in short, which will keep out the cold, and keep in the heat; and such clothing, therefore, particularly that portion of it investing the skin, should be made of comparatively non-conducting material, such as wool, which is infinitely the best for this purpose. The utility of flannel underclothing is generally recognised, although there are not a few individuals in all classes of the community who affect to despise such measures of precaution, under the notion that they keep themselves hardier by avoiding them, and many persons, no doubt, do avoid them with impunity. But in a climate like ours, with its extraordinary changeableness and extensive prevalence of damp and cold, this cannot be done without serious risk even by the most robust. The neglect of flannel for young children is little short of criminal, when we consider how extremely susceptible their respiratory organs are to inflammation brought on by cold. It is impossible to believe that that appalling mortality from bronchitis in children under three years of age to which I have referred, would have been anything like so great had every one of these infants been properly clothed, fed, and cared for. The irritation produced in some by flannel induces them to wear it over a cotton or linen garment in immediate contact with the skin, which of course is better than no underclothing at all, but such irritation is in most instances entirely got rid of after a time, and should it not, then some softer material, such as merino, might be tried. Chamois and other skins, though pleasant, are not so healthy. The underclothing, if of suitable material, need not be very thick,

for this is apt to oppress us when we sit in a warm room, or when the weather takes a mild turn. The flannel should come high up on the chest, a point much neglected by women, who often suffer from their having a large portion of a locality of the body most susceptible to cold comparatively uncovered. The so-called 'chest protectors' worn by many delicate persons, if made of flannel and adapted to the back as well as front of the chest, are likely to be a defence against the catching of a cold. The expense connected with obtaining good underclothing will certainly repay itself and is the soundest economy in the end. The upper clothing should also be of good cold-resisting material, but if the underclothing be ample as to amount and quality, no great advantage results from heavy outer garments. Thick top coats, except for very severe weather, are often a great burden, and to those who are much in the open air, an upper coat of not too thick material is better. Weight by no means implies warmth. Thus in one of the industrial schools in town with which I am connected, the infant children as well as the elder ones were attired in suits of that hard and unkindly material called moleskin, which simply hung upon them and weighed them down, affording very little warmth. A change was made to tweed, and the result was soon apparent in the comparative absence of colds, chilblains, and other winter troubles, which had been before so common.

As to female attire, much might be said did time permit, but only a general remark or two can be made. Even to one possessing so little technical information on these matters as myself, it seems possible to discern in their management of late years the presence of more rational principles, and to find that the dictates of health are to some extent, at least, contesting the sway of imperious Fashion. Nevertheless, it cannot be denied that many of the modern modes of females' dress are not conducive to the maintenance of a robust body—a fact of momentous importance when viewed in relation to the well-being of future generations. There is reason to fear that much infantile delicacy and infantile mortality are directly the result of present or past inattention to their own health on the part of mothers. The tight waists, and tight and thin coverings for the hands and feet, operate

powerfully in producing colds and their effects, since they interfere with the healthy circulation of the blood in the skin, and reduce its resisting power. The frequent neglect of flannel, or its partial and inadequate employment, have a like effect. Rely upon it, that the more sound sense, enlightened by a knowledge of the laws of health, prevail in regulating the manner of woman's attire, although there may be some figures less gainly, and some hands and feet a trifle larger than their owners would like, the grand result would be lives saved, suffering averted, a large increase in the presence among us of typical female humanity, and greater aptitude and power for fulfilling the noble part in the world of her sex. The dress of children, particularly girls, is also open to many objections, and is only defensible on the condition that ample warm underclothing is worn. Every other means calculated to promote the invigoration of the system will to that extent enable us to avoid a cold. Regular outdoor exercise, regular meals, regular hours, early rising, and sea-bathing in summer, are all helpful to this. Means for strengthening those parts most liable to suffer from a cold, such as the respiratory organs, should not be neglected, particularly among the young: moderate gymnastic exercise, skipping ropes, chest expanders, dumb-bells, etc., but especially the practice of singing, which assuredly tends to the nutrition of the lungs, and the development of the chest. It is pleasing to think that the teaching of singing is now so general in our schools, as its bearing upon the promotion of the health is most important; but it should be practised at home as well as in school, and by grown people as well as by children, provided, of course, they are in good health. I cannot help thinking that if there were more singing there would be less coughing.

A word to those who are susceptible to colds. To avoid them more than the ordinary precautions already dwelt upon require to be taken. Keeping the extremities, especially the feet, warm is of great consequence, and for this purpose, besides warm stockings and stout boots or shoes, an inner sole of felt, flannel, or cork is useful. They should, when in the open air, endeavour to keep moving, and they should breathe, as they were intended

to breathe, by the nose and not by the mouth. When out in cold winds the neck should be covered by a muffler or cravat, which need not be thick, but sufficient to protect the skin from chill in that locality, which appears to be a frequent manner of our catching cold. Indoors equal care is necessary to avoid draughts and cold rooms. I am no advocate for fires in bed-rooms, but they are sometimes necessary when the room is large, and there is a tendency to cough after lying down and during the night. The practice of sleeping with an open window in winter is not safe, at all events in the case of the delicate or the very young. Colds may be caught in bed, and therefore there should be ample covering to the body by bedclothes, and by night-dress, which in children should be long and of woollen material. When there is a liability to frequent sore throats, a regular night and morning gargling with cold water all the year through will avail much

Perambulators are now so thoroughly an institution of our day for the locomotion of young children that it would be vain to attempt to discountenance them. In winter, however, they are often the cause of their occupants catching colds, when used in biting winds, or when allowed to stand while those in charge of them are enjoying a talk with a friend, or when the body and limbs of the child are not abundantly wrapped up.

Lastly, let me say that when we feel ourselves chilled and tending to shiver, we should try to put forth a strong effort of the will to resist the feeling, for much evil I am persuaded may often be warded off in this way. If, in addition, we can promptly have recourse to a hot bath for the whole body, and a hot drink —tea, coffee, gruel, etc., are better than alcohol—a cold which might otherwise produce serious results may often be extinguished at the onset. This, however, leads me to the confines of my subject, and to pursue it further would be, as the lawyers say, "travelling beyond the record," for you will observe my lecture did not include the treatment of a cold. This may, perhaps, form a subject for future discussion, for the whole topic is one that is much too large for a single lecture, and I have had to deal

with it in a very sketchy manner. If, however, anything which has to-night been brought under your notice should produce in any of my audience a higher sense of the value of possessing, and the duty of conserving, the God-given blessing of health; or if it should be the means, in any measure, of preventing the evil consequences which we have seen are apt to arise from the hurtful action of cold upon our bodies; above all, if it should be instrumental in saving a single life—even the life of a little child, great indeed would be my satisfaction and thankfulness.

Edinburgh Health Society.

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VENTILATION.

By DOUGLAS MACLAGAN, M.D., *V.-P.*R.S.E.,

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The duty that I have to perform here to-night differs very materially from what it would have been had I been addressing my students in the University upon the subject of ventilation. With them I would have taken for granted that they were thoroughly acquainted with a great part of what I have to say to you to-night, and I would have proceeded at once, and directly, to some of the nicer questions connected with it. But here I must take a different view. I must take it for granted that the larger proportion of those who listen to me have had no opportunity of learning any of those facts upon which the knowledge of the subject of ventilation is founded, and therefore I have to address to them a great deal of what is very simple, and very elementary. I am not going to tell you anything that is new. I am not even going to put anything that is old in a new light. But I am only going to endeavour, if possible, to mention to you one or two facts, and to offer to you one or two suggestions that may be useful to you in preserving the health of yourselves and your families.

The word ventilation may be said to mean, essentially, making use of the wind to enable us to maintain our health. That is the origin and derivation of the word expanded a little. Now, wind is, in fact, the one, I do not say the most important, but it is the one agent in producing ventilation. What is wind? Wind is the air in motion, and I use the word wind in its fullest sense. It is air in motion, no matter how

slight it may be, if it be only one of those little breaths of air that we can only feel upon our faces, grateful to us on a hot summer day, or one of those tempests that uproot trees and unroof houses. It is the same thing, differing only in degree. Wind is the air in motion.

Now, the truth is that the air is very seldom not in motion. It is exceedingly easily moved, and very slight causes produce motion in the air—not merely any mechanical agent that may make a current of air, but the slightest change in the temperature of the air may set it in motion. I am quite sure you must have observed this yourselves, as at the sea-side, for example, when there is not a breath of wind stirring, as we say, and yet when, if you look out to sea, you may see a dark line upon the surface of the water—I can hardly call it a ripple, it is so very small, but yet it is wind, the air in slow motion, perhaps only because a sunbeam has warmed the surface a little, and led to a current of air by the small change in heat.

Now, having said that the wind is air in motion, the next thing that you want to know is—What is air? If I put this question to several of my audience, I should get a variety of answers. Perhaps the first answer I should get from some one is, "Oh, the air is what we breathe." And I say "true," and it is essential that we should breathe the air, for if a man, or any other animal, no matter what, is deprived of air, death must follow in the course of a very short while. An animal will perish in little over three minutes if entirely deprived of air. Now, what is the use of air in breathing? Why do we breathe? Why do we carry on that work of breathing, of which we are not conscious when we are in health, which we carry on whether we are waking or sleeping, and which everybody knows by practical experience is essential to our continuing to live? Now, I must not be led aside from the immediate object of my lecture to-night, but I wish to point out to you why it is that we require to breathe.

It is impossible that any of the parts of our body, any of our bodily organs, can carry on their work unless they are furnished with a full and complete supply of pure blood. Now the blood,

which everybody knows is sent out, in what is called the circulation, from the heart, is, as it goes out, a bright red fluid, capable of nourishing and maintaining the body in full activity; and, unless such blood is supplied to every part of the body, it suffers at once. Perhaps I may take, as the best example, the brain, that most important and most delicate organ of our bodies. Now, the blood is sent out from the heart in this condition of a bright red fluid up to the brain, out to the arm, and down into the trunk of the body and the lower limbs; and after the blood has gone through these different textures and organs of our body, and has for the moment fulfilled its purpose of nourishing them and enabling them to perform their work, it undergoes a significant and remarkable change. Having passed through certain small vessels, and got into these vessels which we call the veins on its way back to the heart, it is now no longer a bright red fluid, but a dark, purple-coloured fluid, and it has lost something that was good for it when it was in the bright red condition, and has acquired something which is bad for it, as far as regards the nourishing of the body. It is now no longer able to maintain the organs of our body, such as the brain, in full activity, and, therefore, if we were supplied only with this our brains would not work, our muscles would not work—in fact, we could do no work at all, we should perish. We must have the blood restored back again to the condition in which it was when it went away from the heart, and, therefore, it is sent by the mechanism of the heart to the lungs, and in the lungs it comes in contact with the air which we breathe, and the blood is restored back to the condition in which it was when it started first from the heart, and is now again capable of maintaining all the parts of the body in vigour and activity. Therefore it is, you see, that it is absolutely necessary that we should be constantly breathing air, and that we should have the air in a pure state, fit for doing the good work upon our blood, and that we should have the pure air in sufficient quantity.

Now, the fact is that the burning of anything, as far as regards its effects upon the air and the effects of the air upon it, is

exactly the same as the breathing of a living animal. A candle will only burn in good air. A living animal, be it man or quadruped, can only breathe in good air. Whether it be a candle that is burning or an animal that is breathing, the air undergoes precisely the same changes, it undergoes a complete spoiling for its subsequent use. And, therefore, if it is not renewed, neither the burning of the candle nor the breathing of the animal can go on properly.

Then, perhaps another of my audience to whom I put the question—What is the air? might say to me—"Oh, the air is that which surrounds us on all sides." Quite a right answer. The whole globe is surrounded by air, what we call the atmosphere. But perhaps another of my audience, who may have had a chance of hearing a chemical lecture somewhere or other, may say—"Oh, the air is a gas." Well, that answer is so far right. It is part of the truth, but it is not the whole truth. It is not one gas, but it is a mixture of gases, and a very remarkable mixture in many respects. Let us look for a single moment at what are the general properties of the air. In the first place, when we speak of the air in ordinary conversational language, we very commonly speak of it as being exceedingly light. We talk of things being as light as air. Well, it is quite true that air is very light. If I lift up a bottle that contains air and a bottle that contains water, then, of course, everybody knows the difference in weight between the two. But you must not suppose that because the air is so very light it has not an appreciable weight. A flask, from which the air has been sucked out by an air pump, and which has been made to balance accurately with a weight at the opposite end of a balance, will descend when air is allowed to get into the flask by withdrawing the stop-cock. Now, you can very easily understand from this that there must be a very considerable amount of weight in the air, if you take into consideration the enormous atmosphere which is above us, and which according to the views of some philosophers extends to upwards of a hundred miles over our head. But take it at half that, there must be, therefore, a very considerable

amount of pressure from this great quantity of air that is above us; and, in fact, the pressure of the atmosphere amounts to about, not quite but very nearly, fifteen pounds upon every square inch. But then, of course, if it acted only straight down as a mass of iron or lead would do, everything about us would be squashed flat. But it operates in every direction, not only downwards, but sideways, and even upwards, so that if the flask had been upside down when the stop-cock was opened, the air would have rushed into it all the same, from the pressure of the atmosphere round about. Bear, then, in mind this most important fact of the atmospheric pressure, and that this pressure operates in all directions.

The next point that I have to bring under your notice is that the air swells very readily when it is heated. And if the air is made one-half bigger than it was by being heated, or twice the size it was originally, then it is perfectly clear that the mass of air must have become lighter. And therefore you must bear in mind that when air is heated it becomes much lighter. This is a most important fact to bear in mind with regard to ventilation. You will easily see the importance of this when I tell you that if, for example, we warmed the air at the other end of the hall and not at this, the pressure of the atmosphere—bearing in mind what I have just said with regard to the pressure operating in all directions—would tend in this way to force itself towards the part where the air was lighter; and, in short, would create what we all know as a draught.

Now, there is a great number of things that are explained by that. Why does the smoke ordinarily go up into your chimney instead of coming out into the room? or when you attempt to light your fire on a cold morning, why may you have the smoke coming into the room instead of going up the chimney? When the chimney is ventilating well, it is just simply this—that the air in the chimney has become warmed by the fire and is lighter than the colder air in the room, and the pressure goes towards the lighter air. But when you have the smoke coming out into the room, probably the air in the room is at first warmer than

that outside, and the pressure comes down the chimney instead of going up it. This effect is seen in the simple experiment, in which I heat one limb of a bent glass tube, with the result that the colder air rushes down the other limb and out at the warm one. Now, what you have seen me do in that very simple experiment is one of the most important things with regard to one of the most important industries of the country. That is the whole principle of the ventilation of a coal mine by means of what are called the upcast and the downcast shafts.

The next point that we have to observe with regard to the properties of air is, as already stated, that it is not a gas but a mixture of gases. In ordinary pure air, as we have it, say in a country place, because the air of towns is necessarily a greatly more impure air from the number of chimneys and so forth, there are always two gases. One of these is called oxygen, and in every hundred parts of ordinary pure air there are twenty parts of this oxygen, whilst the rest of the hundred parts are made up of eighty parts of nitrogen. Now, this oxygen is the first and most important constituent of the air. It is essential to our continuing in life, and therefore some of the older chemists called it "vital air," and a very good name it was, because that is the particular part of the atmosphere upon which we depend entirely for producing all those changes in the blood that I pointed out to you a short while ago. Now, if we set a candle burning in a limited space of air, or if we put a living animal into a limited supply of air, in a very short while—for I told you before the two were the same thing—the candle goes out, and the animal dies, or, in other words, it has been suffocated. That is because the candle, or the animal, has exhausted the amount of oxygen which was in the jar or other space. When I take a jar of pure oxygen, I show you with what brilliancy a candle burns in it.

But with regard to the nitrogen gas that remains in the jar, you see that the candle cannot burn in it. In other words, an animal cannot breathe in this. Not that the nitrogen is in itself a dangerous gas, because every one of us is drawing in quantities

of it into his chest every time that he breathes. You will ask—What is the use of the nitrogen? The answer is, that the oxygen would be too strong for us; we should burn too quickly, just like the candle, and we should perish. And therefore the use of the nitrogen in the atmospheric air is simply to dilute the oxygen and to enable us to breathe it steadily, readily, and profitably.

But there is also carbonic acid in the air, four parts in ten thousand. That is so universally diffused through the air that nowhere do we find the air without it. There is always some of it present, but in very minute quantity, as you see. Where does that carbonic acid come from? It comes from the breathing of every animal upon the surface of the globe, from everything that is burning upon the face of the globe, whether it be a small taper or a burning mountain like Etna or Vesuvius. Both in the act of burning in the case of the taper, and in the act of breathing in the case of the animal, carbonic acid is formed in quantity, and the air therefore becomes contaminated with it. And if, therefore, we have no renewal of the air; if we have not a proper supply of fresh air furnished to us for our breathing, we should go out just as the candle does in a jar containing carbonic acid. Now, you may say—"Oh, that is just our friend the nitrogen back again!" No; it is something very different, as you will see when I mix with it some clear lime water. The mixture, you see, has become quite turbid, and that is because the acid has joined with the lime to form this substance. The same effect is produced when I blow into a jar of lime water, and therefore you see that we are always pouring out a quantity of this gas from our lungs. Now, there is a marked difference between this gas and the nitrogen as regards its properties. The nitrogen has little or no properties except of a negative kind. It won't support burning or breathing, but it won't poison in itself; that is to say, it is not absolutely noxious in itself. But it is very different with the carbonic acid. This is a poisonous gas, has deleterious properties in itself, is capable, in fact, as a poison, of extinguishing life; and all of you must have heard often enough of the disastrous consequences that follow from breathing carbonic acid in very large

quantity mixed with a small quantity of air. Everybody has heard of the results of explosions in coal mines, and how, whilst a great number perished from the direct effects of fire and shock, yet a considerable number perished from what is known by the name of "after damp" or "choke damp," and among them very many of those gallant fellows—for more gallant fellows did not exist —who have perished in going down the mines and endeavouring to rescue those who had been imprisoned within. The lesson to be got from that is to take care and breathe air that is not overloaded with carbonic acid.

But there is something more given off from the lungs than carbonic acid. Moisture comes off from the lungs, and in variable quantity. Everybody knows that from breathing against a window or against a looking-glass, which is always colder than their breath. But that is not so important as what I have now to direct your attention to—namely, that we give off from our lungs also a quantity of what is called—it is a regular technical expression —organic or animal matter. What its precise nature is, we are not prepared to say; but we know something of its properties. I am not going to detain you with the proofs that we have of this fact. But you must take it from me as a fact that we regularly give off in quantity from our lungs, and partly from our skins, a matter that is of the same general nature as the matter that makes up all the textures of our bodies. But, then, it has the property that, being very thin and diffused through the air, it is very liable to undergo decomposition; in short, using the old principle of calling a spade a spade, it has a great tendency to become rotten, and it undergoes the change all the more readily because it is in the presence of moisture and warmth, the circumstances most favourable for decay and decomposition to go on. And then the matter has a nasty, unpleasant, fœtid smell, and becomes not only exceedingly unpleasant but exceedingly noxious. It has, however, one very valuable quality—it is a most reliable danger signal. If you wish to know whether the air in a sleeping-room is in a good state or not, go out into the lobby, or still better, to the outer door after your children have been an hour or two in bed

and if you perceive a "stuffy" smell be sure that there is something wrong with the ventilation.

Bear in mind, then, what are the changes that take place in the air that we breathe. The oxygen disappears, the nitrogen remains behind, the carbonic acid becomes increased enormously; the moisture is much increased, and organic matter is given out. Thus, if the air we breathe is not refreshed always, it gets an unpleasant, fœtid smell, and is noxious. These are the changes that take place in the air.

Now, the object of ventilation is to keep down these things, and to prevent their accumulation, to send back to us a supply of oxygen, and to take care that we have not such an accumulation of carbonic acid that it becomes poisonous; that we get rid of some of the moisture that is round about us, and that we get rid of the animal matter, which, as I have said, rapidly becomes unpleasant and therefore nasty and dangerous.

But you may say to me—"Well, all that you have been telling us is exceedingly curious and very interesting, but we should like to get some practical hints with regard to ventilation." Now, I will offer you a hint or two as to how to provide a little fresh air. I confine myself in what I have to say exclusively to the houses of the people of the working class. I am not giving suggestions now, either with regard to the houses of the better-class population, or with regard to public buildings, because that raises questions surrounded with many difficulties, and I have not time for it.

Supposing a working man, when it is coming towards the term time, wants to take a house, and he wants to see what he shall do to get a house that will answer for himself and his wife and his children. Bear in mind that I am not speaking here about people to whom a difference of a pound or two in the course of the year may be a comparative trifle, but I am addressing myself entirely to those who have to weigh every farthing in calculating how far their income can go in providing their homes, and the comforts of their homes. With reference to the subject of ventilation, the first thing that such a man should do is that he

should see that there is sufficient room for himself and his children.

Now, I speak more particularly with regard to the sleeping apartments, for I think this is perhaps the most important point of all to attend to. The first thing that he will ask is—"How am I to know that there is sufficient room; how many can I put into a particular room?" Now, I don't want my friend to be making elaborate calculations upon matters of this sort, but I want to let him understand, just in a general way, how it is that we make calculations of that kind, as to what is commonly called cubic space. I am assuming here that we have before us a small room of 12 feet long by 10 feet wide, and 10 feet high. The way in which we make out what is the number of cubic feet in that room is to multiply the length by the breadth, and that gives us 120, and then we multiply this again by the height, and that gives us 1200 cubic feet. Now, the smallest allowance of cubic feet for any one, either grown up or children, ought to be 300 cubic feet; and, if you divide 1200 by 300, you get 4, which is the number of people he might put into that room, certainly not more than that.

People very often say—"Oh, that would do very well as an allowance for grown-up people, but less will do for children. It is quite true that children have smaller chests and do not take in so much air at a breath as grown-up people do. But then children breathe faster, and it is of the greatest possible consequence also, that you should do them all possible justice in forming their constitutions when children. And, therefore, I do not think there should be any difference made between the allowance for grown-up people and for children. Let the children have their full allowance.

With regard to the quantity of air required for a human being, this much is known by actual experiment, that if a man be put into an air-tight box, he could not live in the box without suffering, beyond an hour. He would require 2000 cubic feet of air, supposing that no air could get in or out. But, then, of course, as we all know, our rooms are not air-tight boxes. There is a

constant getting in of air under doors, through the chinks of the windows, nay, even through the walls themselves a certain but very small current passes. Now, if we close up every opening into our room as to make it as like the air-tight box as possible, then in a very short while you are just in the position of the man locked up in the box—the air has become so vitiated by your breathing that it is impossible to continue in the limited supply of air without suffering in health. In order to obviate this, there must be some means of letting fresh air in. But that will be of little use, and it would not come in at all, unless there is also a means of letting the foul air out. And, therefore, there must be both a means of outgoing and a means of incoming for the air.

Now, we know very well that in a great number of work-rooms and so forth, the air is exceedingly bad. In the rooms of seamstresses, and the compositors' rooms in many printing offices, the air is exceedingly bad, because there is not only the breathing of human beings, but the burning of a great quantity of gas required for the business. Until recently little or no attention was paid to such questions. But improvement has come with the attention now paid to public health, and I hope such lectures as are given here will have some effect upon this and similar questions. But it very often happens that the fault is not on the part of those to whom the premises belong, but on the part of those obstinate work-people who, because they feel the slightest amount of cold air getting in about them, think that they are going to be killed outright by it, and immediately shut up the holes. Now, if they suffer in their health, it is in that case their own fault.

The object of ventilating a place is to let in the air without causing a current to come in so rapidly as to produce what is commonly called an unpleasant draught. The air should come in very slowly. It has been estimated that it should not move at a greater rate than one or two feet a second, or from 60 to 120 feet in a minute.

What are the means of ventilating in a sleeping room, or in a

room that we are inhabiting? One of the most important means of ventilating rooms is the fire-place. You have already seen how it does that. But it is of great consequence, not only that fresh air should get into a room, and foul air out, but that it should be diffused through the room, so as to renew, as much as possible, the whole air of the room. The fresh air, as a general rule, should not come in at the floor alone. When it comes in there alone, particularly in cold weather, it very soon chills the feet. It is of great consequence that it should enter the room above the level of the heads of those who are in it. With regard to public buildings and so forth, many contrivances are had recourse to for the purpose, but I am not going to enter upon them.

But one of the most important things for you to attend to is to look to the windows, and above all things, to see whether the window opens from the top or not. It is of the greatest consequence that you should be able to pull down the window from the top, and let in fresh air and the foul air out, and to see that the window can be got down from the top easily. But a landlord would say to my friend who is asking him to do this—"Oh, it is an expensive business, and if I am to make all these windows open from the top, I must raise your rent." Well, he would not be beaten even in those circumstances. Here is a little model to illustrate what I mean. Here the upper sash is fixed. Put a piece of board, which can be got for about a sixpence, at the bottom of the open lower sash, and the air will come in above, between the two sashes, and will ascend, and no unpleasant draught will come in to blow things about, or chill the good wife at her work, but the air will spread itself out in every direction, and the whole of the room get benefited by it.

Take care, also, especially with regard to the sleeping rooms—and this is a most important thing—that the beds are not placed in such nooks and crannies that the fresh air cannot get at them in any way. Common sense will guide you in every particular room. But there is one abomination against which I wish to protest most strongly, and that is the plan of putting up beds in

a closet, which may be all very well for stowing away groceries and putting lumber into, but not human beings. When you object to that, some people say—"Oh, but the door is always kept open, and they get the benefit of the air in the room!" But they don't get the benefit of the air in the room, because there is no door or opening in the back of the closet to enable them to get the benefit of it. And, if this is bad for the children who sleep there in health, fancy what it must be if by any chance the children are taken ill with disease. See that the beds are placed where not only air, but daylight can reach them. Daylight is not only essential to cleanliness, but it has a most valuable chemical power of destroying the animal matter, such as comes off from our lungs, and which so readily becomes fœtid. I beg of you never to allow a bed to be put up in a closet or place of that kind, unless there is a fair way passing through it, by which the air can get and pass through it.

Perhaps some of you may say—"That which was told us to-night really applies very well to the house we have been living in for a while. But after all our bairns are wonderfully healthy, and they don't seem to suffer from it very particularly." Are you quite sure of that? Let me tell you what may happen, and what most assuredly does happen very often.

We shall suppose that our friend has a boy at school about nine or ten years old. I suppose that the parent is one of those who wish his children to enjoy a good education, and does not require to be hunted up by School Board inspectors. He is sure that Johnnie is an active, sprightly boy, but after a while it is observed that he wakens sometimes in the morning complaining of a headache, perhaps not very much after all. But he does not take his breakfast very well. That is a very bad sign of Johnnie, and when he goes to school, the school-master sees, and the parent hears with vexation that he is not getting on somehow or other very well; that he is listless and indifferent, and does not say his lessons well. And then they think that that is the fault of the boy, because in the afternoon, when he and his friends are out in the playground nobody runs about more briskly

and no one yells more loudly than Johnnie. But what is the truth? The child has been sleeping all night, I shall say, in one of these airless closets, perhaps some other of the family sleeping with him. He wakens up in the morning with his blood full of this carbonic acid and decomposing organic matter coming off from his lungs. He gets up with his blood half poisoned, and, as you have seen, his brain cannot work unless it is supplied with good blood; and it is not supplied with good blood when it is contaminated with these foul things. But if the school is only fairly ventilated—and every school should be well ventilated—he gets rid of a good deal of this foul matter in the course of the day; and when he gets out into the playground and there gets the fresh air of heaven, he gets rid of all the foul matter rapidly, and then he becomes the brisk and lively boy that he ought to be. Perhaps you blame him, or you may have thought of punishing him. I hope you don't, because punishment is the stupidest way to try to make a boy learn his lessons. The blame does not lie upon Johnnie but upon somebody else, and I leave you to say who that person is.

But something more serious may happen from want of proper attention to ventilation. Your children, we shall suppose, begin to grow up and come to early manhood, or specially let us say, early womanhood; and the daughter of the house, who has hitherto looked well in every way, begins to get a little thin and loses her appetite. After a while you hear her cough once or twice. You suppose she has a slight cold and it will pass away, and you don't pay much attention. But it continues, and she gets ill and grows thinner, and you take her to a doctor. And the doctor says to you, if he is a straightforward, honest man—"Your girl is threatened with consumption!" You say indignantly—"That cannot be, because both I and my husband are strong and healthy, and belong to perfectly healthy families." Well, that may be quite true. Nothing can be truer than that consumption may be inherited, unless it be that consumption may be acquired. And that is what is the case. The whole system of the girl has become lowered, and she takes a little cold. Remember what my

friend Dr Affleck told you last year about taking a cold; it may lay the foundation for that most serious of diseases, consumption, from the effects of want of ventilation.

It may be said, perhaps, that I am raising a bogie in all this, and endeavouring to frighten you. Let me give you evidence that I am not exaggerating. About the year 1856 much attention was directed towards the enormous prevalence of consumption in our army, more especially among the troops known as the household brigade, quartered chiefly in London and its neighbourhood, and there came out the remarkable fact that out of every hundred deaths in those troops about sixty-seven were due to consumption. Now, what was the class of people among whom this occurred? Fine stalwart fellows that had been picked up as recruits, and every one, before being enlisted, examined to see that, at the time at all events, they had nothing wrong with their lungs or anything else. They were not men who were under-fed or ill-clothed. But they were housed in barracks that had not sufficient cubic space, and where not sufficient attention was paid to ventilation, and so consumption occurred in this enormous quantity, which has been immensely diminished since attention was bestowed upon the important subject. We should not forget that much of this improvement was due to a noble-minded man, Lord Herbert of Lea, better known by the name of Sydney Herbert. The same thing has taken place in an infinitely worse degree in the armies of nations upon the continent, but they have been roused up a little and begin to see that the best way of keeping a soldier in good health is to take care that he has plenty of cubic space in his barracks, and plenty of fresh air.

Let me conclude with a single practical observation. I beg of you not to go away from this lecture, or any of these health lectures, carrying with you a sense of the importance of the subject discussed, and thinking that, because you may have bestowed attention as far as you can upon that, therefore you have done your full duty to your families and yourselves. Bear in mind that attending to one thing will not constitute proper at-

tention to health. You may supply the best ventilation that can be to your children, but if you don't feed and clothe your children properly, you are only doing a third of your duty to them. Remember the importance of what Dr Jamieson said to you about keeping the skin acting healthily and cleanly, and bear in mind the importance of good wholesome food for your children. Therefore take care that by no foolish expenditure, still more of course by no vicious expenditure of your means, do you cripple yourselves in your resources so as to be unable to furnish, along with good air, good clothing and good feeding. Don't take one of these health lectures, but take them all with you, and take out of them as much as you possibly can, and try and wind them together, and thus you will be enabled to do your duty properly to yourselves and to your children. I am quite sure there is no one here that will think I am irreverent when I use the words of Him who spake as never man spake, and say—"These ought ye to have done, and not to leave the other undone."

PHYSICAL EXERCISE: ITS FUNCTION.

By CHARLES W. CATHCART, M.B., F.R.C.S.

Ladies and Gentlemen,—I am sure you will not think that because the subject on which I have the honour of addressing you this evening has come in the third series of Saturday evening lectures, whose special title is "Health," it is on that account of less importance than any of the others which have preceded it. Nay, rather, it seems to show the wisdom with which the order of these lectures has been arranged, that a subject of such great importance has been kept back till some of those primary branches of Human Physiology have been explained on which its proper understanding depends. Recalling to your recollection for a moment some of those to which I refer, there was first the introductory lecture impressing on you the importance and duty of taking care of the body, or in other words, of cultivating the physical side of our nature, not only as a duty in itself, but also as bearing in the most important way on the health and well-being of our mental and moral nature as well. Then there followed lectures explaining the general structure and functions of the bones and muscles, of the circulation of the blood, of the method and means of respiration, of the structure and uses of the skin, of the nervous system, and of food and its digestion, while last Saturday Professor Maclagan explained to you some of the great principles of ventilation; and now in some ways we may look upon our present subject as supplementing these, depending on them for its proper understanding, and in turn showing how they all hang together, and how they are all in their way neces-

y for the highest possible condition of health. But when I say health, I may be using a word which perhaps may not be understood by every one in the same sense as I myself use it. I will therefore ask you to allow me to quote the definition of "Hygiene" as given by the late Professor Parkes in his manual on that subject. "It is," he says, "the art of preserving health, that is, of obtaining the most perfect action of body and mind during as long a period as possible consistent with the laws of life. In other words, it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote." Our task to-night then will be to see how physical exercises affect the various vital functions of our frame, and to ascertain if, and how far, they contribute to render "our growth more perfect, and our life more vigorous," and, as a part of the same process, "our decay less rapid, and death more remote."

Now, before we begin to consider the subject of physical exercise itself, it may not be amiss if we glance at a great principle or law which seems to pervade the whole universe of life, so far as we know it, whether of plants or animals. It is that for the proper maintenance of health, there must be a constant alternation of activity and rest, the one following after and preparing for the other. We see it in the seasons summer and winter, in the succession of night and day, light and darkness. A plant that gets its rest in the dark, and that is called into activity by the sunlight, would soon fade if kept constantly in the dark, or would show a sickly over-growth if it were supplied with artificial light, so as to make a never-ending day. Ward, as quoted by Hilton in his excellent work on "Rest and Pain," points out that "Plants in hot countries have their period of rest in the dry season. In Egypt, the blue water-lily obtains rest in a curious way. This plant abounds in several of the canals at Alexandria, which at certain seasons become dry; and the beds of these canals, which quickly become burnt as hard as bricks by the action of the sun, are then used as carriage roads. When the water is again admitted, the plant resumes its growth with redoubled vigour." Thus in some climates the rest is given by

the scorching heat of summer, in others by the bleak cold of winter; but the principle is the same in all, and the types of activity and rest which the seasons and night and day give us for the world at large are true for all the forms of life within it, in whatever way the principle may be carried out for each. It is, moreover, familiar to us all if we would only think of it. We know that if we labour all day, sleep will assert itself at night. None of us could hold even his arm out for ten minutes at a time without tiring of the continuous strain, and it is so well known as to "stand to reason" that if a man is always thinking, his brain will give way, and he will turn mad, or if he is constantly eating, his stomach will suffer, and he will have serious indigestion. This great principle of life we may take with us then as we go, that it is as true for our minds and bodies as for the plants, and as true for all the microscopic particles which make up our bodies as for the bodies themselves, that a regular succession of activity and rest must be provided, if they are to be in a natural condition and lead a healthy life. We shall have occasion to refer to this great principle; but meanwhile let us leave it for the present, hoping that its great truth is recognized, and let us pass now to the consideration of that form of exercise which is specially defined as physical.

Exercise, I need hardly say, means action, practice, or use; and since physical is applied specially to our bodies here, and since the movements of our body, of whatever sort, imply contraction of muscles and movements of bones, we may define physical exercise as "the action and use of our bones and muscles." It is a fact which, though mentioned in passing by Dr Cunningham, may well bear repeating here, that no movement in the body, however slight, can take place without the contraction of muscles or muscular fibres, and accordingly it will be a fitting introduction to our subject if we spend a little time at the outset in looking at some general points as to the contraction of muscles, and as to the mode of their arrangement. After that we can pass to the effects of muscular exercise on respiration, on circulation, on the nervous system, and on the development and vigour of the body

generally; and we will then be in a position to consider some short rules which may guide us in the carrying out of physical exercise and in the selection of its various forms; while, lastly, we shall make a few general deductions from the knowledge we have thus gained, leaving it to some future occasion to enter more fully into the subject from a practical point of view.

To begin with muscles, we find them to be the agents in our body for movements of all sorts, and to enable them to fulfil this end they are endowed with the great characteristic of contraction or alteration of their form in a particular way. If you watch a common earthworm crawling along the ground you will notice that it lengthens its body out, becoming thinner at the same time, and from having first fastened its tail against the ground, it thus pushes its head forward; then, fixing its head against the ground it shortens its body again, and draws its tail up to its body, while as it does this you will notice that its body becomes thicker again. In this way the whole body can be seen to undergo alternate changes in its shape, at one time thin and elongated, at another time shorter and thicker. In other words, the animal has shown itself to have the power of forcibly altering its shape in a particular way to fulfil a definite end. All through the process it must be remembered that the bulk of the worm was the same; it was only its form which underwent change, but at the same time, if the worm had been large enough we might have felt that its body became harder and firmer the shorter it was, *i.e.*, the more it was contracted. Now before we leave our worm, let me ask you to notice another point, and that is, that the effort to shorten was the same at both ends of the worm; and the reason why the head moved at one time and the tail at another, was that the moving end was for the time being the less fixed, while the other was by certain means, which we need not inquire into here, rendered the more immoveable and fixed of the two; the fixed and the moveable end were made to alternate with each other, and thus the animal was able to progress steadily in a certain given direction. Now the changes which you see in the worm, which is a hollow muscle, are in all essential particulars similar

to those which take place in the muscles of our body; and if the above simple facts are clearly borne in mind, you may feel that you have grasped many of the most important points in the contraction of muscle which bear strongly on what we will have afterwards to consider.

Looking on muscle, then, as having this great capacity of contraction, I must remind you that all that which we usually call flesh is nothing else than this muscular fibre. What we eat in animals is almost invariably simply their muscle, whether it be a sirloin of beef, the breast of a chicken, a slice of salmon, or the claw of a lobster. But this mass of muscular tissue is not found in an indefinite heap, as one at first might be apt to suppose, for a careful examination will show that the whole is composed of separate layers and subdivisions, which can be separated distinctly from one another into what are called individual muscles. If you look at a ham which has been cut, in a grocer's window, you will see the red flesh intersected with white lines or streaks—these are the lines indicating for the most part the separation of the muscles from one another; and in the next leg of mutton that you eat please notice that the slices are divided into separate portions or muscles, each often with its own particular kind of flesh. Now, if instead of this rough method of examination, we make a careful dissection of the muscular mass of the body, we will find it arranged into about 400 separate muscles of various sizes and of different shapes. Some are broad and flat, some rounded and cylindrical, but all have this character in common, that while the muscular tissues constitute the active or fleshy part there is an arrangement at each end for fixing the muscle to the part on which it is intended to act. This fixing apparatus is in the form of cords or bands of shining fibrous tissue, and makes what we call the tendons or leaders of the muscles. We may leave out for the present the muscles which move the face, and are thus attached at one end to the skin, and may take those which are fixed at both ends to the bones, as being the more numerous and most important to us at present. These leaders, then, pass from the muscles to the bones, and we find that the

bones are roughened and thrown into ridges at the points of their attachment. This is important, as it shows a tendency for the bone to grow out where the greatest strain is put upon it; and it has thus been found that the growth of bone goes on side by side with that of muscle, thus indicating a relation between the two which at first might not have been supposed. It is so well known, however, to those who have studied anatomy that they can tell at once, from the general appearance of any two bones, what the development of the muscles attached to them has been; and they could pick out one as that of a powerful, brawny man, and another as that of an individual poor and feeble.

But we must not suppose that the muscle itself is simply a large mass of contractile tissue; on the contrary, as we can judge from the grain in a slice of beef, it is subdivided again and again into smaller portions by processes of fibrous tissue which pass into the interior from the outside sheath. The smaller pieces become so small that we are obliged to the microscope in order to discern what we may call the elements of our muscular man. These elements are thus found to consist of delicate fibres or threads, of muscular tissue about $\frac{1}{2}$ an inch long, and averaging about $\frac{1}{1000}$th inch in breadth, and composing when grouped together in various ways the different forms of muscle which we have already indicated.

This muscular tissue arranged so complexly constitutes a large proportion of the bulk of the body, and I must remind you of the great service which its contraction afford us. Not only are all our voluntary movements produced in this way, including the sounds which I am sending out from my throat at present, but all the vital processes depending on movement, and which are beyond the control of the will, such as the pumping of the blood by the heart, and the movements of the stomach and intestines in digestion—all these are in like manner dependent on muscular contraction.

But it may be asked, can all the subtle tracings of an artist's pencil, the tender shades of expression of a human face, be produced by these muscles, which pull only in straight lines? Yes, they can be, and they are; and that leads us to the next point

viz., the forces which cause them to contract. No muscle can contract unless stimulated or excited by a nervous impulse coming from the brain or spinal cord, and accordingly we find that every muscle has its corresponding nerve, which conveys the orders to it from the brain, and without which it must remain unchanged. This nervous impulse is not electricity, but it is something like it, and it may serve to illustrate how the nerve impulse produces a contraction of the muscles if I stimulate the muscles of my own arm with this small battery. As soon as the electric current passes through them you will see that they start into contraction and pull up the fingers. The process is similar when the nerves produce the stimulation, only they have the power of acting on one or many muscles, or on parts of them, in the most beautifully delicate manner possible. Now, the nervous impulse is just as important as the muscle itself, and thus it is that if the connection along the nervous line be injured at any point, or if the activity of the brain be in any way impaired, as by a blow on the head, or by alcohol in excess, a corresponding damage is at once produced in the power of the muscle, however good or healthy its fibres may be at the time.

And now we are in a position to understand why there are so many different and distinct muscles in the body. Each has its own particular action, according to the joints over which it passes, and the part of the bone to which it is attached; and it is by the delicate interposition of one muscle, or part of a muscle, with another that we get all that marvellous variety and delicacy of movement with which we are all familiar, and which is technically called co-ordination. No muscle ever contracts by itself; there may be one or two muscles which have most to do with a particular action, but many other muscles in distant parts of the body must contract along with it, and help it to produce its special result. For instance, if I raise my arm up and hold it fully out from my side, not only are the muscles passing from the shoulder blade to the arm bone contracting, but in addition those fixing the shoulder blade itself to the trunk; and now I must in turn contract some of the muscles of the trunk,

and involuntarily alter the grip of my legs on the floor to meet the unsteadiness which the extended arm tends to produce on my previously well balanced body. Now, although in the simple illustration which I have taken, the necessary contraction of distant muscles was produced, not only without my being aware of it, but also without effort, it was not so the first time I tried it, for each new combination requires practice to enable us to train the other muscles to come in at the proper time and in the proper order. This practical result of co-ordination is called knack, and as its regulation depends on the proper succession of nervous impulses, it shews us another particular in which the nervous system is of the greatest importance to the proper and efficient contraction of the muscles. In passing let us learn a lesson from some of these theoretical considerations. We can see that the exercise of one part of the body indirectly tells upon many others which we would not suspect. Hence the value of vigorous walking, for instance, with the swing of the arms, the balance of the body, and the action of the legs, but hence also the danger of movements which are one-sided and often repeated producing the constant and associated action of certain groups of muscles which may produce changes in the bones and alterations in form which no one would suspect, because apparently not concerned immediately in the movements in question. Who would imagine, for instance, that when you write a letter quietly at a table you require not only muscles in your hand and forearm, but also in your upper arm and shoulder as well; this, however, is an important fact and should not be forgotten, because some of our practical rules for exercise will depend upon it. Another point as to muscular contraction before we leave it, and that is as to the blood supply of muscle. Every contraction uses up so much material derived from the food which acts as fuel, and is, as it were, burnt up in the muscle. The blood parts with its nutrient material which is stored up within the muscular fibre during the period of rest, then when the nerve stimulus comes, the stored material is broken up again, oxygen is absorbed from the blood, and certain waste products, especially carbonic acid gas, are dis-

charged into it, so that it has to be purified in the lungs and kidneys before it is again fit for use. Thus a contracting muscle which in virtue of its life required *some* blood before, requires not only more blood to give it new material and to carry off its waste products, but it requires also leisure and rest to build up new fuel for future contractions. Mr Gaskell of Cambridge has seen under the microscope that the arteries going to a muscle and the veins coming from it are much distended with blood during its contraction, and thus we see how the demand is fully met by the supply; and, as to the requisite for leisure, we all of us know that the greatest trial is an even steady strain, since nothing is more tiring than a continuous cramped position, much more so than a more violent but intermittent effort. All these apparently dry details on the changes going on in muscle during contraction and the resulting alteration in the blood, the increased quantity of blood passing through exercised muscle, and the requisite for alternation in muscular contraction, have an important bearing on physical science as we shall afterwards see, so I must ask you to note them carefully now. At the same time, too, I may point out that similar conditions hold good for all the other tissues of the body in their condition of vital activity, whether it be the brain in thought or mental excitement, or the various glands such as the liver and kidneys, all requiring and using more blood during the period of their activity, and calling for times of leisure to build up new material against a repetition of the same.

Before leaving the subject of muscles and their contraction, let me remind you briefly of what we have seen, viz., that muscles are the agents for all the movements of our body, and this in the larger movements by acting on the bones; that the growth of bones goes on with that of muscles; that muscles are very numerous, have nerves communicating with the brain running into them, and can be made to associate with each other in what is called co-ordination; that besides nerve stimulus they require a large blood supply, the character of which is altered as it passes through the contracting muscle. These latter will much help us

as we pass now to consider the effects of muscular exercise on the various functions of the body.

Let us take first of all *the changes in the respiration during muscular exercise.* We are all familiar enough with the fact that exercise not only makes our heart beat quicker, but causes us to breathe more rapidly and fully at the same time, while the amount of carbonic acid and watery vapour exhaled are much increased. These phenomena have been carefully examined by experiment, and accurate results can be given. In the first place, as to the amount of air expired, Dr Edward Smith has prepared a table showing the relative amounts of air breathed under varying amounts of exercise; taking the lying position as unity, it runs as follows:—

Lying position,		1·
Sitting,		1·18
Standing,		1·33
Walking 1 mile per hour,		1· 9
" 2 miles "		2·76
" 3 " "		3·22
" 3 " "	and carrying 34 lbs.	3· 5
" 3 " "	" 62 lbs.	3·84
" 3 " "	" 118 lbs.	4·75
" 4 " "		5·
" 6 " "		7·

and a few more which need not be given here.

Or, as Dr Parkes puts it, "Under ordinary circumstances a man draws in 480 cubic inches per minute; if he walks 4 miles an hour he draws in ($480 \times 5 =$) 2400 cubic inches; if 6 miles an hour ($480 \times 7 =$) 3360 cubic inches."

But it has been found also that the amount of carbonic acid exhaled during exercise is much increased, and although for a time after the exertion is over the amount as during rest is somewhat below the average, still the total amount is increased, as will be seen from the following table prepared by Messrs Pettenkofer and Voit. I may mention that work here means enough

labour to give moderate fatigue, while rest means quiet occupation with the fingers:—

	Average Elimination of Carbonic Acid in Grains.		Average Absorption of Oxygen in Grains.	
	Day.	Night.	Day.	Night.
Rest, . .	8825·25	6100·73	5771·56	7062·60
Work, .	13217·50	5447·49	8410·44	6720·63
Work Day, .	+ 4392·25	− 653·24	+ 2638·88	− 341·97

These figures no doubt look dry and uninteresting, but we may now associate what is thus proved to take place in the air which is breathed with what is found to happen in the blood circulating through a muscle during its contraction. The muscle uses more oxygen and gives out more carbonic acid, consequently a greater demand is made on the lungs. More air is required, and the blood must be driven the faster through them, and this accounts for the shortness of breath and beating of the heart which we all know by experience to accompany any muscular exertion.

If we reflect on these carefully ascertained facts it will be clear that in cases where the lungs are in danger of suffering from insufficient expansion, and where carbonic acid is thus apt to accumulate in them, and the circulation of the blood to be impaired, great benefit will result from active exertion, more especially if it is such as to call into play the muscles of the shoulder and chest. This is now so well recognised by medical men that the systematic practice of full and deep breathing and the regular exercise of the chest muscles is considered an important element in the treatment of those with weak lungs, or who are already in the early stages of consumption. But surely if this is so well known it becomes every reasonable person in charge of the young to see to it that no such important preventive measure has been neglected as that afforded by healthy, free, and natural exercise. But again, if we look at the demands made upon the air while a person is taking exercise, we will see how very important it is that the air should be not only large in amount, but also exceedingly pure in quality. Let us take as an

example what generally takes place at an ordinary dancing party. A room is filled with people, certainly more than the number which, in ordinary circumstances, it was intended for, or what science would allow, supposing they were all to continue at rest. Presently dance music is played, and the whole company exert themselves violently, certainly as much as would be equal to walking at the rate of four miles an hour. And what is the consequence? Not only do they now require five times as much air as they did before, but they are using up the oxygen and giving out the carbonic acid at a relatively much increased proportion, while people are afraid to open the windows in case of draughts. This is bad enough in itself, but when we remember that this condition of affairs is often carried on so as to encroach on many hours of the time for needful rest, and almost always in a blaze of gaslight, every burner of which, as Dr Wilson told us last year, uses as much air as four or five men, we can see that those entertainments require serious attention and careful management if they are to be conducted on sound principles of health, as I must say I think they might be. Last Saturday we had the advantage of hearing Professor Maclagan on the subject of ventilation; let me impress on you the increased necessity of it when active exercise is being taken.

The late George Henry Lewes in his "Physiology of Common Life," draws attention to the experiments of Herbst, which show that "the same man who when naked was capable of inspiring 196 cubic inches at a breath, could only inspire 130 when dressed," and the late Dr Parkes, in his work on Hygiene, points out as deduction from this and the above physiological facts, that during exercise, whether directly involving the use of the shoulders or not, the lungs should have the freest possible play; therefore there should be no tightly contracting garments round the chest which would interfere with its expansion, and thus tend to neutralise the very benefit it is destined to bestow; and it follows further from this, that where exercise has to be taken in such ill-designed garments, the amount of work done must be in proportion diminished. Dr Parkes having pointed out that the clothing and

accoutrements for a soldier should be made as loose and free as possible over the chest, goes on to say: "And yet till a very recent date (and in our service unfortunately even now) the modern armies of Europe were dressed and accoutred in a fashion which took from the soldier, in a great degree, that power of exertion for which, and for which alone, he is selected and trained." This was written in 1864, let me give you an example from the late Egyptian war. I have received it from good authority, and it will show the importance of the subject, and give you one illustration of the effects of eighteen years longer continuance of custom *versus* humanity and sense. A body of soldiers and a body of sailors had to make a march of three miles in the scorching sun on two consecutive days, and over the same ground. They were both able-bodied healthy men under orders for the war; the soldiers had their tight-fitting jackets, the sailors their loose and free costume. Before the march was ended no less than 130 of the soldiers had fallen out, while every single man of the blue jackets continued in his place. I know of no other difference between the two sets of men, and whether the costume had anything to do with it or not, after all that we have seen I must leave you to judge.

Effect of physical exercise on the circulation.—The heart's beat becomes more rapid and stronger at first, but if the exercise be too violent and prolonged, or if begun too suddenly, then the beats become feeble and rapid, and afterwards feeble and irregular. We thus see that, by physical exercise, within certain limits the blood will be circulated more efficiently and rapidly all over the body, and a healthy glow is, as we all know, produced in the skin. The latter is thus enabled to throw off much watery vapour as well as urea and salts, and so relieve the kidneys of a duty which would otherwise fall to their share. It is plain, at the same time, that unwonted excessive strain must act injuriously on the heart, hence the importance of beginning gradually and systematically any exercise which involves unusual exertion, and as a proof of this physicians find that the greatest number of strained hearts come to them soon after the beginning

of the summer holiday, before the heart is accustomed to the increased exercise. We reserve for those of really weak heart only its milder forms. But in case of misunderstanding, let me point out that some hearts are weak from not having had enough work to do, and the best treatment for these would be systematic and regular exercise, slight at first but gradually increased.

Effects of physical exercise on the nervous system.—I need not appeal to you now for the reasonableness of relaxation and rest to the brain, if it is to fulfil its functions as the organ of thought clearly and well, but I may yet dwell on the different ways in which relaxation may be afforded. To a certain extent, and within certain limits, mental rest is given by change of subject, but after a time then comes the necessity for a relaxation still more complete and thorough, and I would impress on you strongly that for this purpose nothing can take the place of active physical exercise when one feels tired and listless after a spell of close and continuous mental work, there is no better remedy than some active and interesting muscular exertion, which will make the lungs expand freely, the heart beat strongly, and the skin glow and break out into a full and free perspiration. We hear it sometimes said that brain and muscle cannot be developed at the same time, but this is from looking at the question from a narrow and one-sided point of view. It *is* true that many athletes have been and are dull at books, and that many intellectual men have had feeble and ill-developed bodies, but it is not true that there is any necessary connection between weak brains and strong bodies, or between strong brains and weak bodies.

The ancient Athenians have never been equalled for intellectual culture, and yet they made exercise and development of the body one of their first and chief cares, and the perfection of their men and women, as handed down to us in their statues, has been a subject of endless wonder even to the present day. Those who contrast mental and physical culture to the detriment of the latter, forget that the brain, which is the organ of the mind, requires pure and healthy blood as well as any other organ in the body, and if we can find any agent which will strengthen the heart and

expand the lungs while it gives the needed relaxation to the brain, surely it requires no further recommendation from me as one to be encouraged and upheld. But if any one should wish direct proof on the subject, I can refer him to the investigations by Dr Morgan on the oarsmen of Oxford and Cambridge, where the history of each member of the University for ten years was carefully traced, and it was found with reference to class honours that not only was the average of the rowers as good or better than that of any equal number of men taken promiscuously, but that many of them stood in the highest ranks in the Classical and Mathematical Tripos.

Looking at it from another point of view, I may refer to the intelligence and ability of the working classes as a proof that hard and constant physical labour in no way tends to depreciate the quality and strength of brain power—nay, rather, it seems to foster it, for it is out of their ranks that many of our greatest geniuses have sprung in almost every department of intellectual life. As Scotsmen, I need only mention such names to you as Burns, Hugh Miller, James Watt, Sir James Simpson, and Thomas Carlyle, as a proof that the working class has been the stock from which many of our best brains have been bred.

I might easily dwell longer on this part of our subject, but our time is limited, and I must now take up the effects of exercise on the bones and muscles, and on the tone and vigour of the body generally. It is one of the most beautiful principles in our bodily structure that the supply and demand are made to adapt themselves to one another in equal proportions. When a muscle is exercised there is waste of tissue, but it receives more blood and grows stronger, and is thus better able to do the work required of it, while when its use is no longer required it loses bulk and firmness, and becomes less fit for the same work as before. The arm of a blacksmith is rugged and strong—as Tennyson puts it—

> "And arms on which the standing muscle sloped,
> As slopes a wild brook o'er a little stone,
> Running too vehemently to break upon it,"

while a clerk's is rounded and soft; but if the clerk were to turn

blacksmith, and the blacksmith clerk, the aspect and condition of their arms would to a considerable extent be reversed. Now, please note that I say to a *considerable* extent, and not altogether, for this really carries with it one of the great advantages of physical exercise to young people, and it is this, that when the person is young the exercise he takes, or omits to take, will put a stamp upon his frame which he will carry with him to his grave. If, while the bones are soft and growing, the muscles are acting freely so as to open the chest and set up the frame work of his limbs, these good results will remain, although in later life the exercise should be discontinued; and if, on the other hand, while the body is still in that plastic condition, it should be allowed to grow up cramped and undeveloped, no amount of exercise when he is grown up will ever make full amends for this early and unfortunate neglect. On the results of exercise on the chest I am fortunately able to give you precise information. When Mr M'Laren, of the Oxford Gymnasium, took his first batch of twelve non-commissioned officers to train them as gymnastic instructors for the army, he took careful measurements of their chest girth and muscular development, and noted the result from time to time. I need not give details, but the general result let me give you in his own words. "The muscular additions to the arms and shoulders, and the expansion of the chest were so great, as to have absolutely a ludicrous and embarrassing result, for before the fourth month several of the men could not get into their uniform jackets and tunics without assistance, and when they got them on, they could not get them to meet by a hand's breadth. In a month more they could not get into them at all, and new clothing had to be procured, pending the arrival of which, the men had to go to and from the Gymnasium in their great coats. One of these men had gained five inches in actual girth of chest." Now what did all this mean? Not merely growth of bone and muscle, but surely a deeper and wider chest, the lungs so much bigger, the blood so much purer and bringing, accordingly, so much the more vigour and tone to the whole body. To use Mr M'Laren's own words

again, there was "the change in bodily activity, dexterity, presence of mind, and endurance of fatigue; a change a hundredfold more impressive than anything the tape measure or the weighing machine can ever reveal."

To take another example. I have in my eye a certain school where physical exercises have for many years been systematically and thoroughly carried out. The circumferences of the chests have been carefully taken by a trained army instructor (1) of every new boy, (2) of every boy in the school at given intervals, and the results have been tabulated at the same ages. I shew them to you here, and you will see that taking the new boys as those who have previously not had exercise (although some had which unduly raises the average), the improvement by regular exercise as indicated by the table of those at the same age, but who have been at least three months at school, is very marked and striking.

	Aged 14.		Aged 15.		Aged 16.		Aged 17.	
	No.	Avge.	No.	Avge.	No.	Avge.	No.	Avge.
New Boys, .	51	29·3	35	30.6	16	32	6	32·5
Former Boys,	209	30·6	261	32·1	212	34·2	148	35·8
Increase, .	...	1.3 in.	...	1·5 in.	..	2·2 in.	...	3·3 in.

But some one may turn round and say, This is all very well in its way, but what about the intellectual training? And my answer is, if you mean real intellectual training, it is so much the better for this healthy and vigorous frame; but brain power is a different thing from ability to stand well in competitive examinations. The two *may* go together, but often they do not, and many a promising youth at college or at school has fallen in after life into commonplace mediocrity or premature decay from want of that even balance and energy of mind and body which a little systematic exercising in his early days would have given him. If you want better authority than mine, let me quote to you from Dr Beddoe, in his paper "On the Stature and Bulk of Man in the

British Isles." He says, "If we examine only a single race or reputed race at a time, we shall find that whenever that race attains its maximum of physical development it rises highest in energy and moral vigour." And to illustrate this he refers to "Scotland in general, to Northumberland, Cumberland, parts of Yorkshire, and Cornwall, as the portions of evidence which produce the finest and largest men;" and adds, "that it will be acknowledged that they also yield more than their share of ability and energy for the national benefit." I cannot dwell longer on this part of our subject, though more evidence might easily be brought to bear on it; but I think I have said enough as to the effects of physical exercise on the vital function of the body to justify what I will now lay down as a proposition, that *physical exercise is of the greatest importance to mankind throughout life, and in young and growing people its value is simply beyond calculation.*

Let us now rapidly consider some rules for the regulation of physical exercise.

1. It should be conducted in an abundance of fresh air, and in costumes allowing free play to the lungs, and of a material which will absorb the moisture, and which, therefore, should be afterwards changed—flannel.

2. There should always be a pleasant variety in the exercise, and an active mental stimulus, to give interest at the same time.

3. The exercises should, as far as possible, involve all parts of the body and both sides equally.

4. When severe in character the exercises should be begun gradually and pursued systematically, leaving off at first as soon as fatigue is felt; and when any real delicacy exists, the exercise should be regulated under medical advice.

5. For young people the times of physical and mental work should alternate, and for the former the best part of the day should be selected.

6. Active exertion should be neither immediately before nor immediately after a full meal.

Had time permitted I might have said something about each of the rules, but I must content myself with merely enumerating them just now, as it has been my intention in the present lecture to make clear the general principles which underlie all physical exercise without trying to explain their practical application. I have taken this course specially because one is struck in everyday life by the want of sound knowledge on this subject. Most people are content to think that physical exercise is mere "play," to be indulged in occasionally, but not systematically, and that it is not by any means a necessary part of young people's education. I can quite fancy some good people here to-night saying, "why make all this ado about physical exercise, we had no regular gymnastics, no athletic or football clubs, yet here we are well and strong still. Why should not the young people nowadays do as we and our fathers did?" Now, supposing some one has said this, as is more than likely, I will try to give you my answer as shortly as I can. I must then, to begin with, remind you that in every particular we are living at a much higher pressure now than we were even at the beginning of the present century; the rapid introduction of steam and electricity has, so to speak, concentrated our country, and in fact the civilized world, four or five times over; the population in our little island has increased enormously in the last fifty years, and the competition for all means of livelihood has increased at a similar rate. Thus a striving to excel one another has been a marked feature of our life, imposing on all a mental strain which our quieter forefathers knew nothing of. Then the population in the towns has been increasing out of all proportion to that of the country, thus raising entirely new aspects of our problems of social life. In older times when the towns were smaller, and business and professional life less exacting, it was easier to find time and opportunity to get out into the country and counteract the influences of the confinement of the town, and the strong, fresh population from the country was constantly infusing new blood into the towns. Listen, again, to what Dr Russel told us last year—"In Scotland, during the last ten years, the larger towns increased 37·37 per

cent. in population, while the mainland rural districts only increased 2·81 per cent.; and the population of the insular rural—the healthiest districts of all—actually diminished in number by 1·3 per cent." Again, in speaking of England and Wales, and after showing the increase of the town population over that of the country, he concludes by saying—"So that this year the number of dwellers in towns is almost exactly double the number of dwellers in the country." These facts are certainly striking, to say the least of it, but they are more than striking if we read them in the light of Dr Russel's further observations, for he goes on to say—"Now, if there is one fact more than another which the Registrars-General both in England and Scotland delight to din into our ears, and to illustrate and prove in every report, it is that, just as the density of the population increases, so does the death rate—that, in fact, the nearer people live to each other the shorter their lives are." Here, then, are the facts: our country population is rapidly decreasing because deer forests and larger farms are turning the smaller holders out, and steam and mechanical apparatus are taking the place of the farm servant; the population of the towns which brings with it a higher death rate, is multiplying exceedingly fast, and the strain of mental worry is much greater than ever, while it begins earlier and lasts longer in life. How are we to prevent the race from degenerating? Well, Professor Maclagan pointed out that we must not use one means without the other—fresh air, good food, pure water, and now I add one more, healthy exercise, which will help us to have sound hearts, healthy lungs, and clear brains. Do weigh well what I have tried to explain, and if I shall have succeeded in showing you the great importance of the subject, I will consider that the first step has been taken towards the introduction of and provision for physical exercise among us just as much as for any other branch of education.

THE ESTABLISHMENT AND MAINTENANCE OF BRAIN HEALTH.

By J. BATTY TUKE, M.D., F.R.C.P., F.R.S.E.

Last year I started on the assumption that my audience would be practically ignorant of the structure and anatomical arrangements of the brain ; and I accordingly set myself to demonstrate to you certain leading facts connected with its conformation. As I walked home after that lecture was delivered I asked myself the question what good is all that you have said and shown to-night likely to effect? The answer came slowly, and its tenor was very much as follows :—"The knowledge of the public of that great organ, to the disease of which you have been for years directing your attention, is necessarily slight, and if you have conveyed to the hundreds who listened to you so patiently and with so much apparent interest the knowledge that it has a definite anatomy, that it is not a mere mass of white stuff shut up somewhere in the skull, that it has the most important relations to the whole system, if you have given them some reasons for believing that it is the great dominant organ of the body, some good has been done. It is not to be expected that they will have carried away with them all the details, but if you have conveyed the general impression that the arrangement of the brain is as definite as that of the heart and lungs, your audience will be all the better prepared next year to accept your statements as to how the laws of health can influence it." Believe me, I was not and am not, underrating your intelligence. I was

then and am now merely oppressed by the vastness and endless ramifications of the subject, by my own feeling of incapacity to convey to you adequately some little of what is known, and by doubts as to whether I am choosing those portions of this intricate matter which will be of real practical usefulness.

I take it for granted that you have read last year's lecture before coming here to-night, and will therefore only occupy your time for a very few minutes in recapitulating a few of the leading anatomical and physiological facts. I ask you to bear in mind that the *cells of the grey matter are the essential, active elements of the brain*, and that they possess the vital property of generating, receiving, and transmitting nervous influences. As to the generation of nervous influence, I will only quote the words of Hermann :—"In the brain cells certain material processes are accompanied in an inexplicable manner with wholly indefinable phenomena, which characterise what we term consciousness. The term mind may be applied to the combination of all the actual and possible states of consciousness." What these material processes are, we do not know; but that the phenomena of mind cannot be manifested without a material medium, and that this medium is afforded by the cells is amply proved by physiological experiment and by the observation of disease. As to their receptive function, you will remember that I gave you certain definite data for believing that these cells are the organs of sensation, that through them we see, hear, smell, taste, and feel; further, that by the constant education of experience, impressions are stored up in them, and that this storing of impressions we term memory. And as to the transmitting function, you were shown that the stimulus of what we call the Will was inoperative if the cells were destroyed, or if the nervous communication between them and the body was interrupted. There is yet one function to be mentioned. We have good reasons for believing that the cells exercise an influence over the nutrition of the general system, and that when they are imperfect from birth, or become subsequently the subjects of disease, the health of the body is concomitantly affected. I am speaking in very general terms, but I think suf-

ficiently definitely for the purpose of this lecture. Although of late years many great strides have been made in working out the anatomy and physiology of the brain, it must be freely admitted that there are yet great gaps in our knowledge; for instance we do not know whether one cell can receive *and* generate, or generate *and* transmit, or whether one cell receives and passes on the impulse to another. But as I told you last year the general tendency of research is towards the localisation of function in particular parts of the brain. We have, however, to do to-night with what we do know; and I hold it to be a well-ascertained physiological fact that the brain cells are organs which can be acted on for good or for evil, and that they are directly subject to the laws of health. This we will keep before us as a primary proposition.

I am inclined to think that in the mind of the public a greater degree of mystery hangs about brain disease than about any other form of ailment, more especially when it is accompanied by imperfection or aberration of mind. The cause of this is not far to seek—it is the result of the misconception that it is the mind not the brain that is diseased. It is only of late years that it has been thoroughly acknowledged even by the medical profession that such affections are really the result of diseased action in the brain. There is no stronger evidence of the extent of this misconception than can be gained by examination of a book termed "the Nomenclature of Diseases, drawn up by a joint-committee of the Royal College of Physicians of London," and issued in 1869 by the authority of the Registrar-general to each member of the medical profession in order to assist in naming diseases for the purpose of registration. In this work there will be found a list of some nine hundred diseases, a large assortment of poisons, and fifty-seven pages of accidents and malformations under which the body of the Briton is authorised to suffer or die; the mind of the Briton is authorised to suffer from only six "disorders of the intellect;" the idea of bodily disease as associated with mental aberration being studiously ignored. On what principle the differentiation between a disease and a disorder is

founded, it is difficult to say; still there the opinion stands, expressed by very high authority, that Insanity is not a disease of the body, that it is merely a disorder of the intellect. With this fact before us, how can it be wondered at that the public throws a sort of metaphysical glamour over the whole subject, and takes it out of the category of ordinary disease. All this mystery which hangs over nervous disease veiled from the sight of the public that the brain was as much subject to the laws of health as the lungs, stomach, or heart, and induced it to regard many manifestations of its disease as a mysterious dispensation of providence, differing essentially in kind from the thousand and one ills that flesh is heir to.

Turning to the title of this lecture, "The Establishment and Maintenance of Brain Health," I find I have set myself a text on which I might preach for a month, a text which might involve consideration of the most intricate and difficult social questions. It is not difficult to see that in point of fact every question of sociology bears directly on brain health. I am thankful to say that I am not a candidate for the representation of your city, a position, which I may say in parenthesis, is not one conducive to the maintenance of brain health, and I can therefore dispense with discussing such great imperial questions as national education and the liquor laws, improvement of dwellings, and public health regulations, except so far as we are individually concerned.

It may be just said in passing that as a nation we have decided to adopt a system of education which is in itself the greatest brain tonic at our command, a remedy which if not altogether a specific, must strike deeply at one great cause of crime, misery, and degradation. We have decided that every child must be educated up to a certain point. Living as we do in comparative comfort, we are apt to forget in the noble words of Dickens, when speaking of the state of London some forty-five years ago, "How few they are who tenant the stately houses, and how many those who lie in noisome pens, or rise each day and lay them down at night, and live and die father and son, mother and child, race upon race, and generation upon generation, without a home to shelter them

or the energies of one single man directed to their aid—how in seeking, not a luxurious and splendid life, but the bare means of the most wretched and inadequate subsistence, there are women and children in this one town, divided into classes, numbered and estimated as regularly as the noble families and folks of great degree, and reared from infancy to drive most criminal and dreadful trades—how ignorance is punished and never taught—how jail doors gape and gallows loom for thousands urged towards them by circumstances darkly curtaining their very cradle's heads, and but for which they might earn their honest bread and live in peace—how many die in soul and have no chance of life—how many who could scarcely go astray, be they vicious as they would, turn haughtily from the crushed and stricken wretch who could scarce do otherwise, and who would be a greater wonder had he or she done well, than even they had they done ill" (*Nicholas Nickleby*). The Education Act must gradually blur the outline and deaden the colour of this Hogarthian word picture, the fearful and vivid accuracy of which there are many amongst us too well cognisant of. Especially in our great cities, there is a considerable class, the members of which may be termed *moral idiots*. Let me explain this term. We are all pretty well acquainted with the term idiot as applied to a person in whom the intellectual faculties have not been developed. The word "idiot" means a deprived person—deprived of the power of intellectual development. There is a class of intellectual idiots whose idiocy is the result of deprivation of certain special senses; a child who cannot see and hear may be prevented from attaining average intellectual development from the impossibility of carrying to his brain impressions from without. In somewhat like manner we may have people deprived of the power of developing the moral sense. A child brought up, or, rather, dragged up, in a cellar; whose parents are thieves by profession, whose companions are equally degraded, who is surrounded from his earliest days by scenes of debauchery and wickedness, must almost inevitably fail to develop a moral sense. Right is wrong to him, and wrong is right. Strictly speaking,

this is his moral sense. And yet to this degraded creature the law is applied with equal force as to the man of ordinary education. This is, perhaps, a cruel necessity of society for the repression of crime; but it may be fairly hoped that the necessity will lessen day by day as education reaches this lowest stratum of society. As the work of the Education Act goes on, so must the moral idiot become less frequent, and the fearful responsibility of society in punishing the untaught become less and less. Some of us may feel at times inclined to grumble at the expense and working of the Act; but the grumble will cease if we reflect that we, as a nation, are doing our very best to remove a serious opprobrium from society. The Compulsory Education Act is something like the Compulsory Vaccination Act. Society has determined in the one case to apply a preventive to the spread of a serious and dangerous bodily disease, and in the latter to a great and serious moral disease. In neither case may we be entirely successful, but in both we are doing our best to apply the principles of preventive medicine.

And, as a community, we in Edinburgh may congratulate ourselves that we have done, and are doing, our best to clear our city of the noisome dens in which the residuum of society is born and bred. We have cleared away many of the old closes and wynds which were the nests of habitual crime and debauchery. Crime and debauchery can never be thoroughly rooted out, but the action of our municipal authorities goes far to remedy a very important evil, it is gradually preventing or lessening the possibility of the honest artisan and his family living in their neighbourhood. There is no more hopeful sign of the general improvement of our community than those great rows of workmen's houses, which we see starting up in all the suburbs of our beautiful city—not, I admit, adding much to its physical beauty, but affording the means to a great end—giving fresh air and healthy houses to a great and important section of the community, and preventing contamination with moral filth. We have much to thank our municipal authorities for in their action in this matter. Great fears were expressed when the Improvement Act was first put in force that the workman would suffer great inconvenience. In

the working out of all great reforms, cases of individual hardship must arise. I believe such are found in the working of the Factory Acts, the Education Acts, and others adopted for the general good; but, mind you, the general good always comes back on the individual, and, after the first friction is overcome, there is a general feeling of wonder that the old state of things had been permitted to persist so long.

But, putting aside such great measures which have so much to do with the establishment of public health, we will now narrow the question. In speaking of the influences which act for good or evil on the brain, I feel inclined to divide them sharply into two classes. First, those over which the individual has no control; and, second, those over which every man and woman can exercise control. In discussing the first class of influences it will be necessary for me to touch upon certain rather delicate points; but I conceive it to be my duty to do so, as I find them constantly cropping up in daily practice: and, although as regards certain of them, advice may not materially influence action, still I consider it the business of a Health Lecturer to warn, in hope of guiding. The influences over which the individual has no control are those connected with his antecedents and upbringing. A man may be handicapped in life by the mistakes or faults of his ancestors; and, different from the race-horse, he has to carry weight in the race of life according to his imperfections, not according to his advantages.

There is a pretty general consensus of opinion that consanguineous marriages are, on the whole, to be deprecated. It is a matter of general observation, that the people living on or near the border dividing two countries are marked by strong physique, which observation supports the theory that the less closely man and wife are connected in race the greater probability there is of their offspring being healthy. Attacking the question from the other end, there is sufficient evidence adducible that consanguinity of parents tends towards degeneration of race. When we turn to the lower animals constant instances present themselves, and the fact is generally acknowledged by stock-farmers. As regards the human race,

the general outcome of the investigation appears to be that the offspring of healthy cousins of a healthy stock is not more liable to degeneration than that of unrelated parents; but that where there is a family history of constitutional disease of any kind, there is a strong tendency in the children of cousins to degeneration. The objection to the marriage of blood relations does not rise from the bare fact of their relationship, but has its ground in the fear of their having similar vitiations in their constitution which in their children are prone to become intensified. If we task our memories, and try to remember how many perfectly healthy families we have known—families without a history of consumption, gout, rheumatism, affections of the nervous system, &c.—I fear the number we can estimate will be very small; and if we take into account the tendency of such diseases to become intensified in the children of cousins, I think you will agree with me that consanguineous marriage involves a risk which it is not well to incur. Looking back on my own experience, I have very rarely met with an instance in which the children of cousins were in physical or mental condition up to the level of their parents; and I have known many instances in which there was a very well marked falling off, or an intensification of family disease. I think it is in conformity with the experience of most physicians that the nervous system is the one most liable to suffer; and when we take into account the multiform functions of the nervous system, it may be almost assumed that it, of all the systems, is the one most likely to suffer first. This is a complex subject, and I will not press it further. I will only reiterate that the children of cousins are handicapped by a greater liability to disease than the offspring of unrelated parents, and that such marriages are, as a rule, not to be encouraged.

There is one other delicate point I must touch on. I am often asked by anxious parents whether it is advisable to allow their children to marry into families in which nervous disease is known to exist. Of course, as an abstract proposition, there is but one answer to this question—that it is not advisable; but in this work-a-day world it is not often that we can base our action on

abstract principles. In the first place, the public is apt to take nervous disease in the lump, especially insanity. Time will not suffice to-night to explain in detail what I mean by this expression; but I will adduce one or two examples which will illustrate its general drift. The father or mother of a family may become insane far on in life as a consequence of senile decay, or may receive accidental injuries to the head producing mental aberration, or may suffer rupture of a blood-vessel in the brain, and become demented as a consequence of the apoplexy. In all these three cases it may be required to send the subjects to an asylum where they may die. This is enough with a large section of the community to suggest the idea that there is "insanity in the family." A minute's reflection, however, will show that in such instances there is no real blot in the family history, and that there is no more reason for anticipating nervous instability in their children than in a family in which such an incident has not occurred. This type of case excludes a large section of cases from the consideration whether it is advisable to marry into a family in which insanity has cropped up. Again, the term insanity is a generic one, comprehending a large number of various diseases; there are insanities *and* insanities, many of which experience tells us are much less liable to be transmitted than others; so that it is not a mere matter of madness that has to be considered as existing in a family, but which of the many forms comprised in that general term has made its appearance. But even if we admit the existence of nervous disease in a family, are we to say that its members are to be debarred from marriage? I for one say no. There are many other forms of disease which are almost if not quite as transmissible as affections of the nervous system. I have already instanced cancer, consumption, and gout; and if every man or woman is to be debarred from marriage because his family history is not intact, one department of the Registrar-General's returns would seriously suffer. It is quite a different matter if the man or woman has been the subject of such disease; but it has been very rarely my duty, and then under very exceptional circumstances, to advise that proceedings should be stayed where the family

antecedents are not all that could be desired. Even in the cases of previously affected individuals, the circumstances should be most carefully weighed before an adverse opinion is given. Mind you I am not advocating marriage under such conditions—I only wish to express an opinion that there is not much more, if any more, reason for avoiding a family in which there is a history of nervous instability than there is of avoiding families in which other forms of hereditary disease exist.

We may now pass from these more remote points, and consider the practical questions connected with the rearing of the infant and child. Every child's future history depends on the food it gets, and on its surroundings. I remember my much revered and beloved master, the late Professor Syme, used to say, that if you were to take a healthy child born in a palace, and rear it in a cellar in the Cowgate, you would produce a degenerate man, and *vice versa*, if you were to take an infant born in the cellar, and place it in the palace, a well-developed human animal would be the result. This, I believe, to be in the main true. Much depends on the mother; if healthy, she should suckle her child, but not for too long. I have met with many cases in which the sole ascertainable cause of nervous symptoms in young children, was their being too long suckled. This is a far too frequent source of infantile convulsions and other spasmodic affections, which may continue to affect the nervous system throughout life. But the mother herself must be well fed; and this brings me to a question which I should like to discuss in some little detail. In some respects, I believe, the food of the working-classes in Scotland is improved; partly because wages are higher, partly because in the new workman's houses the means of cooking are better, and partly because new articles of diet have been introduced into the market. But I also believe that it has become deteriorated by the disuse of a very important item, porridge and milk, for which has become substituted a much less nutritious and in itself somewhat deleterious article of diet—tea and bread. Need I go back on history to remind you how the Scot in days gone by worked and fought on meal alone—how, with the meal bag by

his side, he marched over the Border and made it very uncomfortable for my countrymen in the north of England; or need I remind you that up to a very recent date, and even in some parts of the country at the present time, the Scottish ploughman worked and works his day's darg on porridge and milk for breakfast, milk and porridge for dinner, and porridge and milk for supper? You probably all remember the story of the retort of the Scotsman (Lord Elibank, if I remember right) who was twitted with Dr Johnson's definition of oats, that it is a grain given in Scotland to men, and in England to horses; "true," said he, "and where will you find finer men and finer horses?" The physiologist will tell you that porridge and milk is a "typical" food, *i.e.*, that it contains all the necessary constituents of food in the most perfect proportions. Now, I appeal to such of you as are forty years of age and upwards, whether, in your own experience, the use of this most excellent and delicious food has not diminished, and the use of tea and toast greatly increased. Now, of course, I have nothing to say against the staff of life, so long as it is sound in quality and well baked, except that it is not such a typical food-stuff as oatmeal, and, weight for weight, does not possess an equal power of nutrition as porridge. Moreover, manufactured bread is not over all of such uniform good quality as raw oatmeal; more especially in our manufacturing towns it is frequently made from inferior flour, and inferior bread can be made to carry a good deal more water than the first-class article. Again, if eaten too new it is indigestible, and if too old it becomes tasteless or sour. But it is the constant use of tea which I would most strongly deprecate. It is an old saying in Scotland that strong tea is "bad for the nerves," and this is certainly true. I daresay you remember Dean Ramsay's story of the Highlander to whom it was remarked that whisky was a very bad thing, "Ay," said he, "whusky is a very bad thing, espeecially bad whusky," and so with tea, bad tea is a very bad thing. The teapot constantly by the side of the fire "masking" a decoction containing, not only the useful parts of tea, but also its really deleterious constituents, is a frequent cause of dyspepsia. Tea is a very good

thing when properly prepared and sparingly used; but even then it takes the place of milk, the most perfect arrangement of food stuffs, and in so doing stands in the way of more thorough alimentation. I hope my teetotal friends will not be very angry with me if I say that it is quite open to argument whether the teapot or the whisky bottle exercises the more baneful effects on the public constitution. I don't think the question has ever been fairly worked out.

In the highest court of the Church of Rome when it is proposed to canonize a person of reputed sanctity, an ecclesiastic is specially appointed to contend against the claims advanced, who receives the designation of *Advocatus Diaboli*, or devil's advocate. I have often felt inclined to assume this thankless office as regards tea when I hear it asserted that it should take a high position among food stuffs. My main contention would be, not that it is absolutely bad in itself, but that it tends to exclude from the dietary of Scotland what has been for centuries the great national dish, and that by the substitution of an inferior diet, and the exclusion of the superior one, the general physical character of the nation must in time become deteriorated. But I would go even further and say, that imperfect nutrition, and the dyspeptic conditions which tea is apt to produce, tend towards the consumption of whisky, and therefore that the abuse of the teapot acts perniciously in two directions. This part, however, I am not going to play to-night, and will merely confine myself to advising all working men, whether they work in the workshop, in the office, or in the study, to feed themselves, their wives, and their children at least once a day on the most perfect form of food which God has given them—porridge and milk.

I am thankful to say that in Scotland there is slight cause for entering a protest against the baneful practice which obtains to a dreadful extent in the manufacturing towns of England, of administering sedatives to infants. There, under the name of "quietness," "soothing syrup," etc., opium is sold, which the hard working mother has got into the habit of thinking she is justified in giving to her child in order to allow her going about her daily work. I merely mention it here in order that should

any of you meet with the practice you may be able to tell the offender that she is sowing the seeds of direst disaster.

In the building up of the constitution of the child, too much importance is attached by many to the use of butcher meat, in fact there is a too great tendency at present on the part of people of all ages to excess in this direction—certainly with children, solid meat should be sparingly used; it is a direct stimulant applied at an age when stimulation is not needed. It would afford subject for an interesting little Roundabout Paper to consider how far the excessive athleticism of the present day is the outcome of an over stimulating diet administered to our youth. This, however, cannot be followed out on the present occasion, and I find the time is so fast slipping away, that I must omit a great deal I was anxious to lay before you as regards the effects of dietary on the establishment of brain health.

The next subject which naturally suggests itself as exercising an important influence on the child's brain cells, is education. As regards this, my remarks will be in the direction of what to avoid rather than what should be done, and this in a somewhat fragmentary manner. In this city of Edinburgh, philanthropy has taken the direction of providing institutions for the education of orphans and of the children of poor people—noble and great institutions which have doubtless effected much good where their function has been exercised for their proper objects. But it is more than doubtful whether they exercise a beneficial influence; if they in any instance take a child from its home and the Board School. I hold that a man must be very poor indeed to be justified in giving up the care of his child; and that he who can maintain even a very moderately comfortable home, outrages the laws of society and of health in debarring his child from its educational influence. Home is home be it ever so humble, and a charitable institution can never be home, however comfortable. To send a child away from the family influence into an atmosphere of necessarily strict discipline and routine should be the last resource of misfortune. The life of a child so placed is artificial, its individuality is endangered, and its experiences circumscribed.

With every respect for the management of these institutions, I would much rather see a child of mine less well dressed, less well fed, living early into real life, his brain cells absorbing real experiences and becoming educated by normal vicissitudes, than see him the best boy in the best hospital. I am speaking as a physician and a physiologist when I advise you to avoid the temptation, should it be presented to you, of sending your children to any institution, when by any sacrifice you can keep them at home. Of course a child has to encounter greater dangers at home than when shut up in a monastic institution; and I will very shortly review one or two of these dangers. Not the least serious accrues from the ambition of parents desirous of seeing their children taking a forward place in their classes. With me it is not a matter of everyday experience that children are overworked or overwork themselves at school. I freely admit that cases of overstrain do present themselves, and further that overstrain is much more common amongst girls than amongst boys. One of the great causes of overstrain in early youth is the vicious system of offering prizes for competition. I believe school prizes to be an utter mistake. Of course the argument is that they stimulate a spirit of emulation; but is a spirit of emulation the proper spirit in which a boy or girl should work, or is the constant pitting of one individual against another the proper direction in which a school-master should labour? I know as a fact that many of our most eminent teachers deprecate the system of prizes, and adhere to it simply because it pleases parents. It deflects the mind of the child from the main aim and object of its study, and often defeats the object which it is hoped to obtain. A boy or girl labours to acquire a certain amount of abstract facts, these are stored up, but in such a manner as to bear little or no relation the one to the other. We hear many ridiculous stories about the results of the examination of children so educated, or I should rather say crammed. I will give you an instance. I have it direct from a Cambridge examiner that the following answers were given to certain questions set at the examination of a Ladies' High School in England:—

Question 1. How many kinds of triangles are there? *Answer.* There are three kinds of triangles—first, the equilateral triangle, which has three sides; second, the quadrilateral triangle, which has four sides; and third, triangles with many sides: these are termed polyglot.—*Question* 2. State all that you know about Nathanael. *Answer.* Not much is known for certain about Nathanael. What is absolutely certain is that he was *almost, if not quite*, the same as Bartholomew.—*Question* 3. What is faith? *Answer.* Faith is believing what you *know* is not true. I can easily understand how such ridiculous results came about. Facts, names, and theories had been shovelled into the brains of these poor girls, and dropped out under the pressure of the circumstances of examination as disjointed as when they went in. And mind you, ludicrous as they were, I strongly suspect that they were not much more so than what are daily experienced by examiners. The youthful mind must not be pressed too far in the direction of abstract facts and theories. Our whole educational system is running somewhat wild in this direction, and the child's brain does not get time to assimilate the food it gets. A sort of brain dyspepsia or indigestion sets in, of which the story I have just told you illustrates the symptoms. My experience may be exceptional, but it tends towards the opinion that the rising generation is not so well acquainted with the standard literature of our own country as boys and girls were twenty-five or thirty years ago. I daresay its knowledge of the hard facts of history is more exact, the rules of arithmetic may be more thoroughly understood, but I doubt very much whether "Robinson Crusoe," the poems of Burns, the "Pilgrim's Progress," Walter Scott's glorious novels in prose and verse, Prescott's "Conquest of Mexico and Peru," and such like educational influences are as much at work as they used to be. In this age of competitive examination there is no time for the study of books which have no direct bearing on an examination paper. It appears to me that we are rearing an educational tree which is apparently strong in the stem, but which is sadly deficient in foliage and in flower; and be it remembered the leaves of a tree are its lungs,

without which it cannot be thoroughly nourished, and without which it will soon become a hard, dry stick. Children are too apt to seek relief from work in the mass of trashy literature which emanates daily from the press. In this there is no real relief; it is a mere frittering away of time, and keeps the child from becoming acquainted with the really softening influences of literature, and gaining unconsciously an insight into the workings of the minds of men whose works have done much to mould national character. Careful reading of such standard books as I have mentioned helps the boy's or girl's brain to assimilate the tougher food it reeeives at school, and introduces a digestive power which helps to diffuse the aliment throughout the whole mental system.

And here I cannot refrain from asking the question, do our teachers administer intellectual aliment as carefully and as thoughtfully as might be? Is there not a strong tendency to administer strong meat to babes, and, moreover, too many varieties of strong meat? I think it will be freely admitted that the scientific study of education is but in its infancy, and that in our system of education many relics of the past still exert their influence. It seems to be taken for granted that all children are alike, and that every brain is prepared to digest the same food. Further, is it sufficiently taken into account not only *what* to teach, but *when* to teach? As there is difference in the periods of development of the bodies of children, so there is difference in the periods of mental development. The present system seems to work fairly well for clever or precocious boys and girls. In most instances precocity is mistaken for cleverness. But mind you there is a pretty considerable contingent of the childish population afforded by stupid boys and girls—probably not stupid in themselves, only stupid in that they are not able to receive and assimilate mental food presented to them at a particular period. With this class I have a very great sympathy, in that they suffer in order that the more precocious of their fellows should be pushed forward. It is only natural that the teacher should prefer the latter and neglect the former. Nor is it entirely his fault

that he does do so, for under existing circumstances school is so pitted against school, so much of a teacher's success depends on the pushing forward of his pupils, that he can hardly help himself. Is there not some degree of truth in the statement that now-a-days the pupil is being made for the school, not the school for the pupil? If it is so, the establishment of brain health suffers.

A great deal has been said and written of late about the overworking of girls and young women in schools and colleges, and my friend Dr Clouston has come forward as the champion of health and ignorance for woman. I cannot help thinking that he has over stated the position of matters, that he has based his opinions more on the observation of isolated cases than on the general condition of highly educated women, that he has mistaken the wail of the one for the murmur of the many. No doubt a certain number of young women suffer and break down *whilst studying;* but this does not necessarily imply that study is the cause of the break down. Is it certain that their systems would not have given way had they been employed in offices or shops or even in domestic service? We doctors often see young girls coming up from the country to domestic service, who are well fed and well cared for, and who notwithstanding from some inherent weakness of constitution suffer from the very same train of symptoms as the young woman who applies herself to study. And even although a certain proportion of young women do suffer from study, is that a reason why the majority of the sex should be debarred from the benefits of higher education? Looking at the question from an evolutional point of view, may we not almost assume that, at the outset of a new departure, a few must suffer? The wide spread higher education of women is a new departure; custom and fashion have shut women off from its prosecution for centuries. If we accept to any extent the theory of evolution we must conclude that the organ which has been neglected for so long may suffer when stress is suddenly put on it; but we may also assume that a very few generations will evolve a power of reception and assimilation in the brain of

the female sex which will render the number of sufferers fewer and fewer. However that may be, I am certain of one thing, and that is, that idleness and ignorance are much more prolific causes of disease amongst women than overwork. They are the main producers of hysteria and of all sorts of vapourish complaints, of many ills and evils to which I cannot here do more than allude, and of inanity if not of insanity. As a matter of fact it is not an easy thing to overtask the energies of the brain by work. It is not work but worry that kills the brain: the latter I fear must be ever with us all. The most highly educated and hard working women whom I have the honour of knowing are eminently healthy; perhaps this may be "the survival of the fittest;" but even granting that it is so—the more women work, the more fit women we will have. One great complaint against woman is that her sense of justice is imperfect—how can it be otherwise if she is debarred from acquiring trained habits of thought? I hold it is better for coming generations that woman should have her brain steadied and strengthened in early life by real study and real work, and that it is not well to rear girls in the idea that marriage is the aim and object of their existence. The time has gone by when the theory is tenable that woman should be regarded or regard herself as a physiological apparatus. This is being practically acknowledged by society, and the force of public opinion is opening up new fields for female labour. It is to be hoped that the field will be even further widened, and that women will drive men out of many occupations in which their physical strength is misapplied, and compel men to seek for work in such manly occupation as is afforded by the army and navy. We may over-run the scent a little at first, and girls may become too ambitious for office work, and despise that most healthy and honourable work, domestic service. But there is little fear but that in this, as in other matters, the labour market will gradually procure accommodation.

But, as I have said, break-down from overstrain does occasionally take place, and I wish very shortly to tell you what the very earliest symptoms are. It is quite possible that the outward

appearance of fair bodily health may be maintained for some time, and, although the student does not feel well, friends and relatives may be kept in ignorance that anything is wrong. The first really important symptom is sleeplessness; when this sets in there is cause for alarm. Work and want of sleep is burning the candle at both ends. Loss of sleep is brought about thus:—when the brain is being actively exercised there is an increase of blood in its vessels—this is spoken of as "functional hyperæmia." If we continue the exercise of the brain powers too long there is a tendency for the blood to remain in too great quantity, from the cells becoming exhausted and not being able to control the vessels. In sleep the amount of blood is diminished, and it cannot be procured if this functional hyperæmia persists. In the absence of sleep the cells cannot recover themselves, and their activity becomes impaired. Headache, loss of appetite, and general listlessness follow; then changes in the character of the blood, and the trains of symptoms so ably described by Dr Clouston. As soon as a child or young person develops continuous headache, work should be discontinued or much lessened.

No time is left us to discuss the influences bearing on the establishment and maintenance of brain health over which the individual has control. In point of fact, this ground has been traversed by former lecturers, more especially in the addresses given by Professor Annandale to young men, and by Dr Angus Macdonald and Dr Halliday Croom to women. These gentlemen laid before their audiences certain pertinent facts, and it would be a mere work of supererogation for me to attempt to repeat what they said, even were it possible to do so to a mixed audience. As these lectures have not been printed, I would urge on the committee the propriety of requesting these gentlemen to repeat these lectures year by year, for such notes of warning cannot be sounded too often.

Were this lecture to be extended it could only be in the direction of the enunciation of a series of moral platitudes inculcating temperance, which would be insulting to your intelligence to submit to you. Every man knows that it is wrong to indulge

in excess, and I would merely remind you that temperance does not indicate merely abstention from alcoholic stimulants, but from excess of any kind. I hold that the lecturer who exceeds sixty minutes in his address is intemperate. I will therefore conclude by saying that I have to-night endeavoured to lay before you certain matters from the point of view taken by a man living very much in the atmosphere of nervous disease. Most men working in the department of medicine that I do recognise that if there is a hope of diminishing the amount of brain disease, it is to be effected by preventive medicine, and I have therefore directed your attention more especially to the transgressions of the father than to those of the son.

DOMESTIC ECONOMY,

As Regards Food and Cookery.

By Miss PHŒBE BLYTH.

When the Committee, who arranged this course of Lectures, proposed that I should undertake one of them, and intimated the subject they wished me to treat of, the first thought that presented itself to my mind was "Clapham Junction," and this word remained so steadily before me for some days that I could not resist introducing our subject to you by this name. Through that Junction there pass in the course of twenty-four hours, no less than seven hundred trains, or one in every two minutes, and so many lines meet there and start thence, that it is commonly said that from "Clapham Junction" you may take your departure for any part of the known world. Something similar may be said of our subject for this evening, as, starting with domestic economy, food, and cookery, we may proceed to any subject we care for, that touches the welfare of human beings.

Political economy, geography, taxes, temperance, employments of various kinds, exercise, ventilation, physiology with its subdivisions of circulation, respiration and digestion, education, intellectual and moral, these and many other points may all be reached, with food and cookery to start from.

In assigning for one lecture a subject capable of such numerous and wide ramifications, the committee have sufficiently indicated the way in which it is to be treated. Only *some leading* ideas can

be presented, *some* principles laid down as general guides, and *some* suggestions made to be elsewhere minutely dwelt upon. It may be that some points will be alluded to that have already been brought before you in detail or will hereafter be so presented. Should I thus repeat what you have already heard, or seem to intrude on the domain of others, I must hope to be excused, seeing that it is consequent on the nature of my subject; for as an engineer who wished to explain fully the use and action of a piston, would have to speak of many other parts of a steam-engine, so a glance must be taken at many points if we would appreciate the importance of cookery and the relation in which it stands to other things.

In our subject, as it is entitled, we have three objects presented to us. It matters *little* in *what order* we refer to these, but *much* that we should have distinctly before us the relations which exist among them. The words "Domestic Economy," or in homely and therefore more hearty "Saxon" terms, the laws of the house or home, lead our thoughts at once to the dwellers in the home, so that we may allow this term to represent "human beings,"—"all people that on earth do dwell." "Food" is too familiar a word to need any comment, but we may pause for a little to consider how and where it is provided.

Here we must extend our view, as food is found everywhere; the sea teems with it, whether we take what the shallow waters give us, search in the holes and crannies of the rocks, or with our hardy fisherman go out to the "deep sea fishing." The air yields its quota, while the earth in all its varied climates gives richly of its vegetable and animal productions. In every direction the continuous and ever-renewed supply is so abundant that were any production unused, it would increase to the destruction or obliteration of others. Nowhere is this more evident than among the "finny tribes." When we learn that several millions of eggs are in the roe of *one* cod, that a perch roe, weighing half a pound, contains 280,000 ova, and that on one shore in Cornwall in one day the yield of pilchard was 10,000 hogsheads or 25,000,000 of fishes, we may quote with emphasis some grand

lines of Milton, used by "Comus" for a different purpose but fairly applicable to ours. He says:—

> "Wherefore did nature pour her bounties forth
> With such a full and unwithdrawing hand,
> Covering the earth with odours, fruits, and flocks,
> Thronging the sea with spawn innumerable?
>
> If all the world
> Should in a pet of temperance feed on pulse,
> The All-Giver would be unthank'd, would be unpraised,
> Not half his riches known, and yet despised,
> And we should serve Him as a grudging Master,
> As a penurious niggard of His wealth,
> And live like nature's bastards, not her sons,
> Who would be quite surcharged with her own weight,
> And strangled with her waste fertility;
> The earth cumber'd, and the wing'd air dark'd with plumes,
> The herds would over-multitude their lords,
> The sea o'erfraught would swell."

Given then these two factors, man on the one side, food on the other, between them comes the cook or cookery. Man has to be *made* strong and healthy or *kept* so; and not only this, but he must be capable of a certain amount of exertion. Cookery should enable us to produce this result in the best way, that is, to the greatest advantage of the food and of the man,—at the smallest outlay of food and the greatest gain to the man.

Let us dwell for a few moments on this aspect of the *use* of food. As we can remember no time when we did not take food, and cannot easily imagine a life in which it would not be required, it seems either startling or superfluous to discuss its use. What! it may be said, do we not take food in order to allay the cravings of hunger, to satisfy our appetite? So it may seem, but this is not the ultimate purpose of taking food, the fact being that appetite exists in order to incline us to take food, not food because of the appetite. The French dramatist Molière, in his play of "The Miser," represents that miserable creature, when he *must* have some guests at dinner, as arranging with his cook for a repast of which only very little can be eaten, for it is to consist of dishes which

will soon cloy and surfeit whether or not they nourish those who partake of them. He defends this proceeding by the philosophical remark that we should not "live to eat," but "eat to live." When we, like him, recognise that we do not "live to eat," but eat or should eat for the sake of not only *living*, but *living well*—that is usefully, nobly, serviceably in the "God-appointed when and where"—we exalt the place of her whom the Germans tenderly call the House-mother, with whom lie the choice and preparation of the food.

We have to do then to-night with no trifling or insignificant question, but with one of vital importance. That it is so, let me show by a single example related by Mrs Buckton:—"A few years ago several of our soldiers who lived in some London barracks were nearly starved to death. They became thin and weak. On enquiry, it was found that they never had anything but boiled meat, which was boiled to a rag and the liquid thrown away." In the liquid went all the strength of the meat. Here we see how a set of strong men, for whom nourishing food was provided, got no good from it entirely from the ignorance of the person who prepared it.

I understand that I am to give the A B C of cookery for the use both of those who do all their own cooking, and of those who only direct or judge of the cooking done for them. In this, as in other cases, if the alphabet be well known and its resources understood, an ordinary intelligence can make a right use of its combinations, and even experiment upon new ones. If the *why* and *because* of some dishes or processes be made plain, a great step in advance has been taken by the would-be cook. Instead of giving you a number of receipts, we shall employ this test in some directions, and mark how it opens up to us principles which can be widely applied.

For example, we take the useful and constantly needed process of boiling potatoes, for which we find the following directions:—

1. Wash potatoes in *cold* water, never hot. Why? Because warm water would draw away some of the nourishment.

2. Potatoes are best when boiled in their skins. Why? Because the most nourishing part is next to the skin, and the skin not being porous, keeps in the nourishment.

3. Old potatoes are put on the fire with *cold* water, while young ones are put into boiling water. Why? Because *slow* cooking is needed to get to the heart of the old and somewhat *hard* tuber, while it would make the young ones soft and watery.

4. Do not cover them with water till they are about to be set on the fire? Why? Because if they stand long, even in *cold* water, nourishment is lost.

5. Let all the potatoes boiled at one time be as nearly as possible of the same size. Why? That we may not have some hard and others in a pulp, but all equally well cooked.

6. Keep them covered while they are being cooked. Why? Because if the pan be wholly or partly uncovered, the steam in escaping carries off some of the heat, and involves prolonged cooking.

7. When they are sufficiently cooked the water is poured off, and they are again set near the fire merely covered with a cloth of loose texture, or with the lid of the saucepan tilted to one side. Why? Because we must now let the superfluous moisture escape that the potato may be mealy, not watery.

Again, in looking through most cookery-books we find certain receipts in which we are told to beat up eggs as a whole, while in others we are directed to beat the yolks and whites separately. Does mere caprice dictate this? Certainly not. There is a *principle* by which we can reduce what seem mere arbitrary irregularities to one single rule, as can be easily shown. The yolk of an egg is largely oleaginous or oily, in its nature, while the white being albuminous, is viscid or sticky. When beaten together, these make a smooth mass; but when the latter is beaten alone, it forms a froth or foam of air-bubbles, small at first, but expanding as everything does under the influence of heat. Here, then, we have our guide. When we desire only the *richness* of eggs, we beat yolk and white together, when we also require *lightness*, we shall do well to beat them separately.

The actual processes employed in making food fit for the use of man are few; they may be almost exhausted in the short list of boiling, roasting, frying, broiling, and stewing, whether under a cover of pastry or not, with the preparation of tea, coffee, and cocoa.

Some principles are of such wide application that they refer to one, two, or even three of these processes. Let me give you an example of this. In the cooking of butcher meat one of two purposes must always be in view, and different means must be employed as we aim at the one or the other. We either wish to keep the strength and flavour *in* the meat, or we wish to get them *out*. When we boil meat to be presented as a joint, we wish to keep the flavour *in;* when we use it for soup, we wish to get the flavour *out*. With such different purposes in view, we must treat the meat differently.

The existence of albumen has been referred to in previous lectures, with the fact that it coagulates, or becomes softly solid at boiling heat, as is most familiarly seen in a plain boiled egg. By plunging our meat, suppose a piece of mutton, into boiling water, the water is put off the boil; it must then be allowed again to reach the boiling point, when it will harden the albumen of the meat through a thin coating on the surface. If we allow the saucepan to remain on the fire, at the boiling point, this hardening process will go deeper and deeper into the mutton, hardening more and more albumen, till at last we have a fine tough piece of meat to present at table. No one enjoys it; while it is eaten, sundry complaints are made against the butcher for his bad mutton, and we may find realised, the definition of digestion given by one who had been crammed with intellectual food unfit for her to digest. The definition runs thus :—"Digestion is pains in the head, pains in the stomach, bad tempers." If such an occurrence were to happen once to an inexperienced but right-minded housewife, she would not be content with this, she would inquire here and there from the experienced, and armed with better knowledge, when she again provides mutton for dinner, she adopts a different course from the first. This time,

as soon as the water with the mutton in it has boiled for a few minutes, she draws it aside to simmer, not to *boil,* till the mutton is sufficiently cooked. The coating of hardened albumen which was formed at first keeps in all the juices, as it stops up the pores by which the flavour and gravy would have escaped, while the simmering cooks the meat and this time a tender nutritious dish is the result.

If this plan for keeping *in* the juices of meat be once thoroughly understood and taken hold of, its wide application in various ways will be very serviceable. This is the reason that when meat is to be stewed it is *browned* first, as we do not wish much of the juices of the meat to pass into the gravy. We attain the same end in *roasting*, by applying a strong heat for the first ten minutes, and a gentler one afterwards. When we cook a steak on the gridiron, wishing to keep *in* every particle of the nutritious juice, we must take care to have a hot, clear fire which will quickly form the outside coating of solidified albumen; this we must not injure, and therefore the cookery-book warns us against plunging a fork into the steak, and the ironmonger supplies us with beef steak tongs. We have here, too, the explanation of the treatment of meat that has to be *re*boiled—a ham, for example. In its first boiling, all the juice is kept in by the thick, hard skin of the pachyderm which supplies it. Should it be so partially cooked that it is necessary to repeat the process, something must be provided to take the place of this skin, and prevent the juice from passing into the water, so that nothing but insipid fibre will remain. This purpose is attained by covering the joint with a moderately thin paste of flour and water—a paste which is easily removed; thus leaving the ham well cooked and with all its original flavour.

Let us now see what is to be done if we wish to *withdraw* the juices from a piece of meat. We then plunge the meat, whole or in pieces, into water, *cold*, or very slightly heated, to simmer for hours. No coating of thickened albumen is made, and the juices of the meat are drawn out from it to enrich the water and transform it into soup, or with the addition of barley and vegetables into our own wholesome Scotch broth. Meg

Dods (keeper of the hostelry at St Ronan's Well), and a great authority in cookery, asserts that in this matter of soups the French stand first, the Scotch next, and the English below them both—the difference arising chiefly from the greater or less amount of time allowed for amalgamation. She refers, of course, to popular practice not to lordly kitchens. Her assertion will be stoutly denied by those who think only of a weak liquid in which float independently, grains of hard barley and pieces that may be counted of vegetables, but will be assented to by all who know how substantial a meal may be made of good barley broth, well thickened with vegetables, and which has been from four to six hours on or at the fire. This slow boiling softens, plumps and whitens meat, and facilitates the removal of scum, an important matter either for soup, broth, or boiled meat.

This sort of reasoning might be carried on indefinitely and always with advantage. I hint at only a few more points.

Why should bread that is to be added to soup be toasted? Because if untoasted, the bread will swell, crumble, and spoil the appearance of the soup. Cheese is presented with preparations of macaroni, or other Italian pastes, *because* they have no flavour in themselves, and we must add some to make the dish palatable, as well as to increase its nutritive power. The state of the fire is of paramount importance in frying, *because* with too strong a fire the fat becomes so hot that the substance placed in it is merely scorched without being heated through; and if the fire be too weak the food will be *stewed* in fat, not fried.

I give one more instance before I pass on to another phase of our subject. You have been told that starch exists in large quantities in many vegetable productions, one-seventh of potato, one-half of wheat, one-third of peas and beans, three-fourths of rice and of Indian corn being starch; that arrowroot is only starch from a tuberous root, and that tapioca and sago are nearly pure starch. We learn, also, that starch which is insoluble and indigestible in its simple state is digestible if exposed to the action of an acid and then to heat, as it is then converted into sugar. We all know, too, that sugar dissolves easily in liquid,

so in this condition produced, as it is by digestion, what *was* starch and is *now* sugar is taken up by the blood, and by its circulation to all parts of the body, it imparts heat and force. We have here the reason why all foods containing starch must be well cooked, as otherwise the starch cells will not burst, and though they are received into the body they do it *no good.* This applies to wheat, oats, sago, potatoes, etc., while other vegetables, such as onions, and tomatoes, which have little or no starch, *may* be eaten raw by those who have a taste for them in that state. This last illustration leads us to remark that within or beyond each of the "whys" and "becauses" which have been given, there are other "whys" and "becauses" which might be entered upon; but these take us into the region of chemistry and are not needed for the practical cook in her daily work.

While it is desirable to *know* such points regarding the *theory* of cooking, it is equally necessary, or perhaps more so, to *practise* it as an *art;* indeed, although art has been defined as "knowledge applied to a practical purpose," yet in the experience of individuals, as in the progress of civilization, art *precedes* science, for material wants insist on being satisfied. The *practice* of cookery arranges itself under two heads, according to the age of those concerned. First, come children and young people, who may be helpful, or even skilful in some parts of the *art* of cookery, such as the gathering and preparation of vegetables, points of cleanliness, order, &c., &c., long before it is wise or needful to speak of the science involved in what they do: it will be a great good, however, for their after life, if these points be made so habitual to them as to be matters of course. They can use their feet to run and their hands to work, sooner than we should tax their brains to think.

Some cooks never get beyond this handicraft and so remain always in the lower ranks, but when "knowledge" or, if you choose, "science," is added to art, the whole subject of cookery is raised. It will be matter of congratulation should the book-education, now so largely insisted on, result in this higher view of every manual work, not in the foolish idea, sometimes expressed

and even acted upon, that it is undignified or unworthy of consideration.

Again, practice is important to those who are at the head of affairs, in order that excellence may be secured; this applies to everything, from the infusing of tea or making of porridge, to producing good broth or rich pastry—the skilful operator must be kept well in practice by frequent repetition. This may seem a superfluous remark, but it can scarcely be deemed so in view of the hours of daily practice given to *at*tain or *re*tain rapid manipulation on a musical instrument, contrasted with the *one* occasion held to be enough for learning to prepare a good dish. In Miss Mitford's "By-gone Days in our Village" we find an account of some children who tried to spin, but had the grief of seeing the flax which had passed in a fine thread through the nurse's hands, snap in theirs. "Why cannot we do it, Peg?" they say, "it seems simple." "Just, bairns," answers the nurse, "because ye maun first *learn* a thing 'fore ye can do it *well*; it's only *practice* that makes *perfection*." This aphorism applied by the nurse to spinning, has equal force in reference to cooking.

Having thus considered the relation of food to man, and the need of cookery to enable us to make a good use of the raw materials, with some of the means to secure this, let us now look at some of the conditions by which the food in the first place, and cookery in the second, can be secured: for it is not enough for these ends to have a house with a woman in it, though we might sometimes think so from the way in which the question is spoken of. We have abundant scope for going far a-field here, as many paths diverging from our "junction" attract us. Of these we can follow only a few. Honest labour on the part of the man; trouble, time, and thought on the part of the woman, with frugality and thrift from both. Of the labour, which is to provide all that the housekeeper must have, I scarcely need to speak, except to note that besides the actual food to be consumed, it must supply fuel, materials for cleaning, a proper choice of utensils, and that these materials and utensils must be renewed from time to time: this belongs to him who bears the high name

of the "bread winner," the husband, the bond or strength of the house. This last item of utensils is of moment both as an expense to be provided for, and in its influence, as on it depends much as possible economy of fuel, of labour, and of provisions. It bodes well for a new household when the kitchen, or the "but," is fitly set up with deal table and dresser, with useful crockery and ironmongery, before the room, or the "ben," gets a mahogany table, a mirror, or a piano.

Labour of another kind is required from the wife. Her labour generally includes the selecting and purchasing of provisions, which must be done with judgment and forethought,—the preparation of this food, often requiring a great deal of time,—and next, the actual cooking. With her rests the whole question of delicate cleanliness in herself, in the food, and in all the utensils used. Dishes must be fresh and sweet, no particle of fat should be left in the sauce-pan, no flavour of onion or fish in the frying-pan, knives have to be scoured, kettles burnished outside that they may quickly boil, crockery scrupulously clean both outside and inside so as to be pleasant to handle, the very tables and floor should be free from greasy or other stains, and each meal should be orderly in its arrangements.

For all this, and for the process of cooking itself, *time* is needed, and some of you must have anticipated the conclusion I would press on you,—that the house-mother must be *in* the house. Of all the devices of modern times, none is more ruinous for the physical, mental, and moral welfare of families than that of the wife and mother being withdrawn from her place in the house to go out to some other work. Hours might be spent on this subject; I must content myself with a few weighty words from a speaker at one of the meetings of the British Association. "The mother must retain her true place in the household, if the household is to be comfortable, the children properly nursed, the food and clothing sufficient and nourishing, the father attached to his family, and his home. The welfare of a family will be more promoted by a mother at home, than by her adding a few shillings a week to the family income at the cost of diseased and

dying children, of unfit food, of discomfort to all, and of expensive habits in an absent husband." *

This leads us directly to the question of thrift, or the art of thriving. I am pretty sure of a hearty response when I express my conviction that you all want to *thrive.* Can I be as confident, and will you be as cordial, if I say that you are all ready to be thrifty? Some people speak of "thriving" as if it meant *only* and *always* a good deal of money coming in, with no reference to *how* it is to go out. The good proverb, "a penny hained is a penny gained," has no meaning for them, and so pence are squandered till shillings disappear, and the shillings soon mount up to a crown, which makes a large hole in a pound. This is not the time to enumerate the many injurious ways in which money is thus squandered. You can supply the blank for yourselves. I will mention only one,—the many coppers that, in some houses, are given to children for sweets and cakes. I am told, by those who have the means of knowing, that this outlay is sometimes more than the weekly school fee, while I *know* that where children are under proper control, one copper a week suffices them. This is but a sample of the want of thrift which keeps down many a family, and greatly hinders good feeding. We all agree in disapproving of the practice of living "from hand to mouth," as the saying is—meaning that no sooner has the hand secured some good, or the means of procuring it, than it is immediately consumed by the mouth. Bad as this is, matters are far worse when the mode of living adopted is from "mouth to hand," by which I mean that the mouth *first* consumes what the hand must *afterwards* provide the means of paying for. It has been said, and said truly, that as there is a dignity in earning money, there is also a dignity in spending it. This is true, but to have this dignity, the spending of money must include many good things, and, *imperatively*, it must mean freedom from debt, with the independent and upright feeling which this bestows. Those who are not only free from debt, but can pay *when* they purchase, have many advantages over those

* Rev. Worthington, at Bristol Association at Nottingham, 1866.

who have "a *book*," as the saying is. The one knows how far she is going, the other soon loses sight of the state of her accounts, and is distressed and over-weighted when she finds herself far beyond her reckoning. Again, those who have money in hand can purchase at an advantage when a glut in the market lowers prices, or, they may buy such quantities as give an advantage to the purchaser, and benefit in articles, which, like soap, improve by being kept. The practice of purchasing in very small quantities—just what seems wanted for the coming meal, is a most extravagant one. The *actual* cost is more for a small quantity than for a larger one; then there is the waste of either too little to make the dish good, or too much, while it is so little beyond what is needed—that it is not considered worth setting aside; and so it is wasted. I need not dwell on the great gain of the *ready money* system—it is patent to every one in the co-operative stores, which depend entirely on this for the low rates at which some of their goods are sold. The purchaser, with money in hand, can do better than even at a Co-operative; for if one dealer can only offer what is unsuitable in itself, high in price, or poor in quality, the purchaser can go elsewhere and choose for herself. The poor thrall of "a book," as a running account is called, can make no such choice, but must take what she can get.

Now, this independent action can be secured in any class only by fixing the habitual expenditure below the income, so that when work is slack, or sickness invades the dwelling, there is a reserve which can be resorted to, which will keep away the grim figures of want, debt, or begging. I am not drawing upon my fancy in these remarks. I know of those who have for years lived from mouth to hand, and who never get over the hill Difficulty, or out of the slough of despond. I know, too, and could tell you, did time permit, of others who never spent beyond what they had, and have, step by step, risen from grinding poverty to comfort and independence, who are maintaining themselves, and have even a reserve in the bank. Thrift, properly understood, is wholly removed from parsimony; it does not mean food of bad quality, or a table so scantily supplied that it whets the appetite with a

desire for more, while it fails to appease it by what is supplied—it means the purchase of economical, not dear pieces of meat—it means slow and careful cooking—it means abundant meals, which seem to bid a welcome to all-comers. Neither does thrift refer only to humble homes; it is said to be less frequently found among the wage-earning class than among those who have salaries, though the annual receipts may be less in the latter than in the former case; and I *know* that in many kitchens of those that are called rich, such economy is practised, such good use is made of everything that enters them, as would either surprise or shame others with smaller incomes.

I must now consider thrift in the actual cooking. It is said that the better the cook is the more economical will she be. I would modify this a little, and say that the more *intelligence* a woman has, the more economy can she exercise in her kitchen. I have told you how the application of a few principles will get the full amount of nourishment from what is provided, but intelligent thrift will do more, for it will provide a good savoury meal out of what is only waste to an ignorant housewife. A skilful combination of what has been left at one or two meals, with the addition of a savoury or sweet seasoning from the store closet, will "hain" many a penny which otherwise would be wasted. Remnants of bread, a crust of cheese, scraps of meat, remains of fish may all be dealt with in this way. You have seen in the tables presented to you on other occasions that animal and vegetable food each furnish, though in varying proportions, the different requisites for wholesome food. Without confining ourselves to a diet, either wholly or mostly vegetarian, much money might be saved by a diet drawn less from the animal kingdom, and more from the vegetable kingdom than is now common. The variety thus provided cannot easily be exhausted. The garden gives us roots, tubers, bulbs, leaves, pods, and seeds. The orchard yields its fruits, and the field its cereals or grains; white farinaceous foods are prepared from different parts of plants. With such a choice, and a little meat or fish with spices, there is no end to the combinations that may be made.

We are here brought into contact with the need and benefit of "variety" as an important point to be attended to in arranging the food and cookery of a family. Each meal should in itself supply the different ingredients required by our bodies, *fat, oil, or starch*, to make them warm—fibrin, to give flesh; minerals, such as salts, to make bone; and so on. Many popular dishes meet these requirements, and have become matters of habit and taste, while they are scientifically good, such as—Liver and bacon, beans and bacon, bacon and greens, bread and cheese, bread and butter, cow-heel with sauce of milk, a little butter, and seasoning of parsley, rice with milk, suet, or cheese, bread or potatoes and meat, tripe and onions, fat pork and pease pudding, butter to white fish. When the Irishman eats his potatoes with butter-milk, or the curler, after hours at the rink, sits down to his fat beef and greens, they are taking what they like, but they are also taking what is very good for them. And so with a dish not much used here, kol-cannon. The potato is poor in gluten, the cabbage is unusually rich in this production; mix the two and you approach the composition of wheaten bread. Beat the potatoes and boiled cabbage together, put in a little pork fat, salt, and pepper, and you have a kol-cannon with all the qualities of Scotch oatmeal, and which to some would be more savoury and palatable. A mere potato-eater, fed on this dish, soon becomes stronger and more active. Lastly comes our wholesome national dish of oatmeal porridge "chief o' Scotia's food," with milk, if possible, and failing that, with molasses or treacle. I cannot speak of porridge without turning aside to regret that it is a less usual food than it once was. We can no longer quote as strictly true Dr Johnson's definition of oats as being "food for horses in England, and men in Scotland;" and the result is not a happy one, for neither can we now adopt Lord Elibank's rejoinder, "that nowhere can you see such men and such horses." It is said that even our convicts have a less powerful physique than formerly, and English visitors to Edinburgh sometimes look in vain for the stalwart forms they expected to find in the natives of Scotland. It might be incorrect to ascribe this deterioration

entirely to our change of food, especially for children, but certainly that is one element in the result, and it is not pleasant to think that the change is often made merely because either time or trouble is grudged, certainly not for thrift's sake.

The list I have given shows very markedly that variety does not mean costly dishes. Simple stuffs judiciously alternated, or with only a change of seasoning will secure what is needed. For example, let us add to flour and suet, at one time, a little treacle, at another, some preserves, another day, a handful of dried fruit, and we have three varieties of dumplings; and a fourth and fifth may be provided by putting either apples or an onion within the paste. You will observe that some of these will be more appropriate for one season than another, because more easily obtained then, while others may be had at all seasons. Variety should also appear when one meal is compared with another. Whether sameness happens with tea, as it sometimes is here, or with damper as it Australia, the result is bad. A properly arranged diet will avoid this, and will alternate lighter with more substantial meals. Variety must go beyond this, however, and should include changes, from day to day, of all but such simple things as bread and porridge. An unvaried repetition even every *week* is to be avoided.

In providing this variety, we have many aids — every season brings a change of fish, flesh, or fowl, as well as of vegetable products; commerce brings for our use the productions of every clime, and even legislation helps us by alterations in the tariff, as in removing the tax upon sugar. This variety without unwarrantable outlay, calls for ingenuity on the part of the housekeeper, but it is worth her trouble, as she gives it not merely to please the palate, but that by it she may stimulate the appetite, give a relish to the food, and improve the digestion. We may often get hints on such points from the habits or treatment of the lower animals; and here we may learn from the dairyman. As he requires to vary the food of his cows, if he is to keep up the full supply of milk, in like manner must we vary the food we provide for our households, if they are to be strong and

hearty. High authority can be given for this mixed diet. Hall, Bishop of Exeter, afterwards of Norwich, referring to his own employment, says: "One while mine *eyes* are busied, another while my *hand*, and sometimes my *mind* takes the burthen from them both; wherein I would imitate the skilfullest cooks, which make the best dishes with manifold mixtures." You will observe that the *variety* recommended lies in the material used, much more than in the processes adopted, as we have already noted that they are not very numerous, and may be included under Boiling, Stewing, Baking, Roasting, Frying.

Let me now present two "Interiors" for your consideration—the one to be condemned, the other to be imitated. In the first (which is borrowed from Soyer), The husband, who is employed by a railway contractor, and is what the world calls middling well off, arrives home, and asks his wife what he can have for dinner, the hour of her dinner, and that of the children having long passed. "What would you like to have?" was her question. "Anything you have." "Let's see? why—we have nothing, but I can get you a mutton chop, or steak." "Can I have nothing else; I am tired of chops and steaks." "Why, Jamie, what can be better than a chop or a steak?" "Well, let me have a steak." "You had that yesterday; now, let me get you a chop. I always make it my duty to study your comfort; and I have been reading not long since, that nothing is so wholesome as a change of food, since which time I have made a point of varying our bill of fare, as they call it." "Very well, send for two chops." In a few minutes the messenger, whether wife or child, returns, saying she could get no chops, but has got a nice piece of steak. "Very well. That will do as well, will it not?" to her husband, who is reading a periodical. "Yes; but how long will you keep me here before it is done?" "Not a minute, just enough to do it well on the gridiron." The fire, however, is not fit for broiling. "Well, I shall fry it," she says. The husband, hearing this, exclaims, "Drat the frying-pan, it is always so greasy." "Then, how would you like to have it?" "Not at all," is his reply, throwing

down the paper; "bother the place, there is no getting any victuals properly cooked here. I must go to the cook shop and have it." He seizes his hat, and slamming the door, makes his exit in a passion.

I have presented to your imagination a scene in a disorderly, ill-arranged home, where little or no forethought is given to the family table. Let us now look at the reverse of the medal. The father, toilworn it may be after a day of bodily labour or mental harassment turns towards his home, and as he does so a warm glow of love to those whom he will find there kindles in his heart. He arrives neither fretful nor impatient. His wife is tidy and fresh, the table is prepared, and while a short time is given to the needful "cleaning," the viands are dished, and the father, mother, and children seated. The parents have their dinner, the children their evening meal. They are orderly, obedient, and perhaps silent for a time; only "the lisping infant prattling on the knee" can be tolerated at first—but soon each tells the "ferlies" that have been seen or heard, and the meal is one of refreshing family intercourse. Has the cook-mother no pleasure, do you suppose, in the kindly approbation given to what she has provided and taken trouble in preparing? Has she no reward in seeing how it is relished, while she knows how little money has been needed to give a wholesome and nourishing meal? You know little about it who say so. This should not be all, however, some return should be made to her for all her toil and care. But does not the case often stand thus. The man has been from home, where he had variety in the people with whom he came in contact, variety in the occupation which exerted his powers, variety in the very surroundings he has had, whether of open air, business mart, workshop, or warehouse, and yet there is a prevailing idea that it is *he*, and he alone, that requires and should get entertainment of some sort in the evening. Would it not be fair that he should give this variety and cheering to his wife whose duties have kept her all day, or nearly so, within the walls of her own house, or with probably no intercourse beyond that with her own children,

which cannot be called companionship? Is it not fair that he should now unite *his* efforts with *hers*, among the children in whatever direction they are needed, and when, after evening worship, if the household be a god-fearing one, the bairns are asleep, are there not confidences to be made to her? plans to be laid for the family life? accounts to be made up for the past? calculations for the future? or some parts to be read from the newspaper which he likely has in his pocket, so that she who has little time for reading may be kept abreast of his social and other interests.

In this large assemblage, there must be, not only *some*, but *many* who are familiar in their own experience with all I have said, and who could and would have said it all themselves, had our places been exchanged. Their houses are the abodes of happy content, cheerful industry, and godly honesty. Cleanliness reigns there, and thrift is practised. Of such homes we hear little, but they are training "honest men and bonnie lassies," who are to be the strength of our country in the coming generation. We know—and it is a joy to know—that in all classes there are such houses—true *homes*. If some from these homes are disposed to be disappointed or displeased with what I have said, or have left unsaid, I beg them to remember that it was not to such as they that I required to speak. The object of this course of Lectures, of which I have had the honour and pleasure to give one, is to instruct the ignorant, to advise the inexperienced, and to warn the imprudent. If they serve also to encourage the well-doers, they accomplish what is desired, and make all who engage in them fellow-workers with Him whom we call our Lord, part of whose work was to strengthen the weak and to cheer the down-hearted.

I must now draw to a close this discursive address, which perhaps has won *too well* a right to be compared to Clapham Junction from the various paths we have taken, wandering in many directions, though never, I trust, missing our points so as to get upon wrong lines. Many parts of our subject have necessarily been left

untouched, such as cold-meat cookery; cookery for the sick; food for infants or children; salting of meat; quantity for each person, varying with age, sex, or employment; the need of taking food in *fresh* air, not where hours have been spent in working. Neither have I given you receipts for dishes, nor directions for cleaning, as these are to be found in every manual on Domestic Economy, and to them I refer you. I have only endeavoured to show that to attend well to the food and cookery of a household means that the hands, the head, and the heart are all needed; for she who attends to it must work with the hands, think with the head, and feel with the heart that this duty is one which neither exalted piety nor high intellect should look askance at as beneath notice, but is so important as to deserve the careful, continuous, and intelligent application of whoever has the charge of it.

I have told you that to succeed in it there must be such forethought and wisdom in forming plans, and such diligence in carrying them out, that the house-mother's place is one neither to be lightly thought of, nor ungraciously acknowledged, but to be held in high honour and esteem.

My aim has been less to exhaust any point than to awaken a lively interest in the subject, and to show what conditions are required for the economy of the house. If that aim has been accomplished, it remains for the honest industry of man and the ingenuity of women, stimulated by wifely and motherly love, to make the family table the centre of much good, while she merits the praise of being one who "looketh well to the ways of her household and eateth not the bread of idleness."

DOMESTIC ECONOMY,

AS REGARDS

Clothing and Household Arrangements.

By W. ALLAN JAMIESON, M.D.

If it is permissible to venture an opinion, I have a suspicion that the members of Committee of these Health Lectures chose for me the first item of this subject, because having last year spoken about the skin as nature formed it, I was bound this year to tell how art protects it. This is all well. But how about the household arrangements? these have but an indirect connection with clothing. On this point I must fain shelter myself behind the Committee. They are infallible; and having put clothing and household arrangements together, and asked me to give my deliverance on these severally and conjoined, I can but endeavour to fulfil their wish to the best of my ability.

First, then, of clothing. Very different indeed are the ideas of mankind as to this. Among the least civilized of the human race, it is little more than a means of protection from cold, an adjunct to be dispensed with more or less entirely in proportion as the spot of earth's surface on which they dwell receives a larger or a smaller share of solar heat. Civilization has, however, made the use of clothes absolute; yet even here the instincts of savage life in this as in more serious aspects peep out now and then. See how eager children are to divest themselves of shoes and stockings, and career in freedom on the sands. Or how again during summer the juvenile population of streets occupied by the working classes are never so happy as when with bare feet (to the horror and astonishment of our Southern brethren) they can play

untrammelled on the flags. And well for them. The muscles, cramped and pinched by the hard shoe, have full scope, and the foot gains in strength and pliancy what it may lose in softness.

The object of clothing varies under different circumstances. Thus in cold climates its purpose is to retain and economize the heat which is constantly being produced within the body by vital processes, such as digestion, respiration, muscular exercise, and brain work. Were this heat not conserved by our clothes it would depart rapidly by radiation and evaporation. This loss is aided materially by cold winds and a temperature without very much lower than our own. Necessity, therefore, as much as civilization compels us to wear clothes in order to keep ourselves warm. A further reason, not unknown among savage nations, is that of wearing clothes for display.

In hot countries again the body must be covered as a protection against the direct and scorching rays of the sun. It is still, I believe, a disputed question whether the dark races of mankind owe their colour to a gradual process of tanning by the beams of light acting on generation after generation, or were primarily dark. A brown skin, however obtained, serves to lessen to its possessor the danger of direct solar heat, while the skins and bodies generally of the fairer races, partly from not being habituated, partly from want of this protective dark staining, are, when exposed, affected injuriously by the tropical rays.

When we turn to the materials of which, and the mode in which, our clothes should be made, two points claim notice. Our clothing should be as light as is consistent with sufficient warmth. Weight is burdensome, and it should be so fashioned as not to interfere with the proper movements of the body. Easy clothes are much warmer than tight ones, and, paradoxical though it seems, they may be said with equal truth to be cooler in warm weather. Admitting of more perfect ventilation, they do not so readily become moist with perspiration, and then cling unpleasantly to the wearer. Some materials permit heat to pass too quickly through them, and do not sufficiently impede evaporation. We have, however, many substances which only admit of the gradual radiation or escape of heat from the

body. Of these, wool of many different sorts is most generally suitable; and this is fortunately produced in such abundance and at so reasonable a price that all can obtain clothes made from it. And in regard to this we can, as so often happens, take a hint from Nature. Those of the lower animals which, from their mode of life, are necessarily exposed to great alterations of temperature, have a loose open fleece or hairy covering, so a loose, open-wove porous material makes the warmest garment. Hence knitted underclothing and fleecy or thick soft cloth for outer wear are cosiest, though it must be admitted not in all cases the most durable; at least when we take into account some trades and occupations. Colour, too, has an influence. If equally thick, dark stuffs are warmest, because such absorb more of the sun's heat-rays. Light coloured articles of dress reflect more of these rays, and hence are cooler. Grey presents a medium tint which suits our climate well. I said, if equally thick; this is not absolutely true, but it enables me to make a practical observation which every one of you could, I believe, confirm from his own experience. More colds are caught at funerals where black clothes are still almost exclusively worn than anywhere else. Now this is partly, I admit, because these black clothes are, as a rule, thinner than the everyday dress; partly because a degree of depression is, not unnaturally, experienced when we place in their final resting-place the remains of one who while alive was loved or respected. Wearing mourning is a relic of heathenism handed down to us from Roman times. The custom is certainly now-a-days much less rigorously observed, and some have abjured it, as the Society of Friends do. Is it not an apparent protest against Christianity? which while it robs death of its sting, at the same time teaches us that that is but the narrow portal, only gloomy to those who are looking on, which ushers into perpetual day and perfect peace. If some mark of reverence for the dead be thought necessary, let it take the form of a badge, which, worn on our daily clothes, might tend to inspire hope and cherish faith.

Taking up clothing in order, underclothing should always be of wool, and all ought, in this eccentric climate of ours—but the same rule applies to such an one as India,—at all seasons to wear

woollen materials next the skin. This is even more imperative at the two extremes of life, in the case of infants and young children, and aged persons, whose powers of producing heat are less active than those of individuals in the vigour of middle life or of youth. They are therefore less able to resist cold. In winter, either hand-knitted under-vests and drawers, or machine made, in imitation of hand-knitted, are best. In summer these woollen under garments should on no account be entirely laid aside, but when the warm season has fairly set in, here scarcely ever till June is well advanced, thinner and lighter ones made of merino should replace the thicker worn in winter and spring. If any article of underclothing is to be thrown off in summer, it should be the drawers, the under vest never during the day. And here I may remark, that *all* clothing worn in the day time should invariably be put off at night, to be replaced by cotton or linen night dresses. Too many wear under-flannels night and day. The good effects which result from wearing flannel next the skin are thus much lessened. Flannel is worn by day when one is actively occupied, and the perspiration is thereby increased, to prevent our becoming suddenly chilled. This is unnecessary, as a rule, during sleep. Flannel night dresses are preferable, in the case of children, to linen or cotton. They have less heat-producing power, and are besides much more apt to throw off the bed-clothes. For them a night dress, made somewhat like a bathing costume, suits best, as it is then impossible that, though the bed-clothes are tossed off, the child can be entirely exposed. In old persons, and in those with strongly developed rheumatic tendencies, flannel is also the best material for night dresses; but in all these cases there must be special garments for day and night, each to be reserved for its proper time and use. At night the feet must be kept warm, warmed artificially if cold on going to bed, since, unless they are warm, it is not possible to sleep soundly—in many instances even to sleep at all. Underclothing for use in the day should not extend further down the arms than half-way to the elbow. This permits much greater freedom of movement for the arms. It should never be allowed to become too dirty before

being changed, since this renders it both unwholesome to the wearer and unpleasant to those around him. It gets loaded with perspiration and particles cast off from the skin, which, being animal products, tend readily to decompose. Besides, clothes much soiled are more difficult to wash, and being more worn in the process, to permit them to become so is the reverse of economy. A week is the limit to the time they should be worn before being changed, and thus an endeavour should be made to have a sufficient number of underclothes to allow of this necessary frequency of change. There is no special virtue in coloured flannel. One often hears red or blue flannel, especially when new, credited with surprising qualities. It is certainly a doubtful advantage that such does not show dirt so soon as white or cream-coloured. It is assuredly not warmer; indeed, brightly dyed wools are often the cause of eruptions on the skin, from some irritating ingredient in the dye used.

The material of which what may be termed intermediate clothing is made, varies in the two sexes. Whatever its component parts consist of, these should not be tight; and, in the case of females, strings and tapes tied round the waist as a means of sustaining any garments are to be avoided, suspension from the shoulders being better. Were the strict underclothing, that worn next the skin, made warm enough, perhaps worn double, there would be less need for the multiplicity of skirts and heavy petticoats still used by some. One woollen under-garment is not so warm as two, even though the one be as thick and as heavy as the two are. The two are separated by a layer of air, and so heat is less rapidly transmitted and lost. Something of what is known as the Bloomer, or rather the modern combination dress, might very well replace all but the gown proper. A very warm material, and not heavy, is found in chamois leather. An under-dress of this has really reason, besides elegance, on its side.

So much has been said on the subject of stays and tight lacing, and with so little real effect, that it seems almost hopeless to offer any suggestion. As to the existence of tight and very tight lacing, one has nothing more to do than take a walk along Princes Street any day in summer to note how many waists are

natural, how many artificial. The large proportion are the latter. It may be admitted that a moderately small waist does, in the case of some women at least, improve their personal appearance, dressed as many are at present. But while this is conceded, does the advantage gained as regards display counterbalance the unquestionable evil effects of forcibly compressing the centre of the body, and displacing and injuring important organs? Many women complain that they cannot walk uphill or upstairs without feeling short of breath. Much of this is due to the natural expansive movements of breathing being limited to a minimum by stays. Their effect, bad in all cases, is worst in growing girls, whose ribs are still yielding and elastic, and thus more easily compressed. Parents are now becoming somewhat more alive to the fact, that there must be for girls as well as boys a due proportion of free out-door exercise associated with the lessons at school. In too many girls the natural supports of the spine, the muscles of the back and chest, have partly been left undeveloped by want of exercise, partly been wasted and cramped by the pressure and the artificial support of hard, unyielding, and too often tightly laced stays. Hence it is that far more girls than boys have twisted spines. Girls would be as straight as boys are usually had they only fair treatment. The muscles of the back being weak, the girl sits habitually to one side or other, and what was at first merely an awkward habit, becomes very soon a decided curvature. It is most unfortunate that there hardly exists a playground worth the name attached to any girls' school. In winter, a large hall should be available for games, gymnastics, and romping generally, in summer, a space out of doors; and were the play hours superintended and the play joined in by the teachers, both those engaged in imparting knowledge and those learning would be the better in every way.* Muscles as well as brains must be exercised and trained to be fit for their work, for muscles are as necessary for women as for men; and if these were the objects of more attention, we would have women better

* Some admirable remarks on this and kindred subjects are to be found in a little book "On Physical Education," by Concordia Löfving, published by Sonnenschein & Co., London, price 1s 6d.

educated, and at the same time more fitted for becoming in time active wives and healthy mothers, or indeed for any duty. Women would certainly then be more free from those severe backaches and that distressing pain in the left side, of which one or other many of my female hearers are but too painfully conscious. It seems to me that this is a most legitimate sphere for the exercise of the energies of those ladies who have their sex's welfare so much at heart.

I am sometimes told that stays are absolutely necessary; without them women would look, it is said, like sacks tied round the middle. If something must be worn to support the figure, a softer and more pliant article might easily be devised. The corset recommended and used at the Girton Ladies' College is reported to be such.

There is a passage in one of the works of a very vigorous and talented authoress of the present day which is worth quoting.

"Miss Lizzie Vane wore a dress which faithfully followed every worst point of the prevailing fashion, and exaggerated all of them a little, by way of originality. Her gown was the gown of the present day. It fitted her almost half the length from her throat to her heels like a skin: it was well tied back just behind the knees, and on the ground behind an abundance of perfectly meaningless little frills arranged upon a spoon or wedged-shaped piece of stuff, waggled and whisked about with her every movement. . . . . .

"Her waist was, let us say, very slim indeed; her bust and hips forced into a prominence displeasing in itself and out of all proportion with the rest of her figure. Her plentiful hair was gathered behind into as small and shabby a round knob as it could by any means be screwed into; in front a great wisp of it was pulled forward, relentlessly cut short, and then curled, frizzed, piled, and towered, both on the front of her head and over her pretty white forehead." Who can say this is an overdrawn picture? It may be conventional thus to distort the human form, but it is not beautiful. Let the dress exhibit natural lines rounded and easy, as they should be in health, to the full, but do not

forcibly misplace portions of the body, to the destruction of health, and the sacrifice of ease, elegance, and grace.

Of those varied humps and prominences which are developed artificially under the direction of fashion from time to time on different parts of the female form, there is nothing to say. They in general reach such proportions as to interfere so much with comfort or progression, that apparently a protest is made, for they vanish and are seen no more. As a rule, they are not actually injurious.

Though the stays may be loose and easy, or absent altogether, dresses are often made or become too tight across the chest. Girls will frequently say, "My dress is not, does not, feel too tight." Yet when it is unbuttoned or unhooked, it will be found that a space, and often a considerable space or gap, exists between the buttons and the button-holes, when the shoulders are held only properly back. This should not be. Such dresses prevent the lungs from expanding in the movements of respiration, interfere with easy and full breathing, narrow the chest, round the shoulders, and favour, if they do not directly lead to, consumption. Dresses for grown up persons should be full across the chest, for growing girls specially so; and when made at first ought to have enough cloth laid in to permit of ready enlargement, for a dress often becomes too small before it is worn out.

In selecting materials for clothes, all staring patterns should be avoided. Self colours or quiet combinations are best. A draper once told me that in ordering goods he had invariably to select some uncommon patterns,—those he showed me might very fairly have been called ugly,—because there were always customers who must have dresses quite distinctive. As regards material, it is always best to purchase really good cloth in the first instance, since honest fabrics always look well when new, and even when worn for some time keep their shape and colour better than inferior ones. Apparent bargains in clothes not seldom turn out anything but satisfactory in the end. When good clothes have been used for a time, they can be made down for children's wear. Thus it is well to bear in mind when selecting clothes, the purposes for which they are to be employed, and whether, though at

the outset designed for better, they will eventually be suitable for work or home duties.

There is an old proverb, "Keep the feet warm and the head cool," and there is more wisdom in this than in many other wise saws. Carried out fully, it is an excellent maxim. Though in summer cotton socks are certainly cool and pleasant, when one can wear thin shoes, and there does not exist any necessity for walking a long distance, woollen stockings are actually much more suitable at all seasons. The late Professor Syme once remarked to his class, that were cotton socks worn all the year through, colds in the head would be unknown, and cited himself as an example of the practice and consequent immunity. But alas for the infallibility of human opinion, not long after I saw the worthy Professor sneezing and otherwise manifesting the signs of as well-marked a cold in the head as one could have. Woollen stockings woven of coarse yarn absorb the perspiration and preserve the feet from blistering, and are cooler than cotton ones on a long walk. Tight garters are frequently worn below the knee by women. "Garters in any position are bad, but if used they should be worn above the knee, as the two tendons to be felt at the back of the joint receive the pressure and act as a bridge to the veins which pass beneath. The garters as usually worn are a frequent cause of enlarged veins in the leg, and by interfering with the blood supply of the foot, also favour the development of chilblains."

Boots and shoes must be easy, broad in the toes and sole generally, while the waist should have some degree of elasticity and not be absolutely rigid. Shoemakers have, it seems to me, an idea that the foot is formed as follows: a great toe in the centre, flanked on each side by a smaller, and outside this again by another still less or little toe. Hence their boot with pointed toe. If any one will examine an infant's foot, still guiltless of stiff shoes, the natural shape of the foot will be found displayed. The length of the great and two adjoining toes will be found to be nearly the same; indeed, sometimes in infancy one or both of these slightly exceeds the great toe in length, the other two toes are shorter. There is also a small space between the great

and second toe, and it was here that a thong which helped to secure the sandal worn by the ancient Greeks was carried up. The great toe and the inner side of the foot form a straight line. Compare the infant's foot with your own, and the distortion which the shoemaker has brought about will be at once visible. The great toe will be found to incline outwards towards the other toes, at a greater or less angle from the perfectly straight line of the inner side of the infant's foot. The smaller toes are more or less bent, perhaps plaited one over another, and can either only with difficulty, or not at all, be straightened out fully. One or more of them have corns, while the nails are misshapen to some extent. All this arises because shoes in general are made more or less wedge-shaped at the toes, and the foot must adapt itself to this imaginary and erroneous model. The normal foot becomes continually broader from the heel to the toes. Boots and shoes are advertised as being made on an anatomical model, but in actual practice the mischief is done while the foot is growing, while fashion and the desire for small feet encourage the evil. The savage who walks barefooted clings to the ground with his foot, which in fact is nearly as pliant as his hand. Much of this prehensile power or capacity for grasping is lost among civilized nations, who wear hard unbending coverings for the feet, but the elasticity, the springiness which the arched form of the instep imparts, remains in great measure if the foot be treated properly. High and narrow heels give an insecure hold of the ground, and throw the weight, which ought to be distributed over the sole, forward on the front part of the base of the toes. This unnatural position, besides rendering the risk of sprained ankles much greater, stretches the fibrous bands which bind the various and complicated bones of the instep into a beautiful arch, strong yet springy. The tough fibres yield, the foot flattens, elasticity and grace of movement disappear to a large extent, and aching pains are often complained of, the cause of which may be easily misunderstood. If we wish to walk elegantly, comfortably, far, and with ease, straight broad soles and low heels must be worn. The fashionable boot, with its thin sole, its narrow, high, pin-like heel, and its pointed toe, gives a tottering gait

quite different from the firm and secure tread we ought to have.

As in the case of dresses, attention should constantly be paid to children's boots and shoes, so as to have them lengthened or renewed as soon as they tend to become short. The foot elongates considerably too in walking, so all boots should have a full half-inch or more of spare length to permit of this. Women's boots and shoes are generally far too thin. Besides being worn thicker, the addition of an inner sole of cork covered with felt excludes damp from the ground or pavement, and aids in keeping the feet warm. These soles should, however, be taken out and dried at night or when the boots are laid aside. Lacing boots are better than elastic side ones, though in some ways the latter are more convenient. Patent leather boots are only suitable for occasional wear; like goloshes they do not allow the escape of perspiration, hence are unhealthy, and if worn constantly engender habitual cold feet.

In winter, at least, woollen gloves should be worn, as best preserving the proper circulation of the blood in the hands, and lessening the chance of chilblains. In the warm seasons silk or cotton ones are preferable to kid.

The second half of our proverb still demands notice. We are told to keep the head cool. Were it possible to form a covering for men's heads which would admit of both light and air in due proportions, a great problem would be solved, as I am certain that baldness would then be reduced to a minimum. No plant can grow in vigour and health unless it has light and air and sufficient nourishment, and the hair may be regarded in one sense as a plant. How do we treat it? We exclude air by wearing a heavy silk hat, which at the same time keeps it in darkness, and we starve it by attaching this hat by means of a hard rim pressed down on the head, which squeezes the arteries, and thus diminishes the proper blood supply. Since hats are a necessity, they should be light, "feather weight," pliant as far as may be, well ventilated, and with a soft band which will compress the arteries of the temple as little as possible. The hat, too, should only be worn when it cannot be laid aside—not constantly, or when in the

house. Ventilation is best secured by having a slight space between the band and the hat proper in front and behind, the hat being close to the head at the sides. It thus does not so much convey the impression of being over large, as when ventilated in this way at the sides also it is apt to do. In addition, there should be a hole in the crown in the hat for cold weather, in the sides and crown in that for summer use.

What can I say of that marvel of variety and elegance, a lady's bonnet? It is, or it ought to be, the perfect setting round a fair face. Like the humming-bird, which, alas! too often adorns it, it is so delicate as to be destroyed if handled rudely, and that airy lightness of pencil is not mine which is requisite to deal with it adequately. At the present moment, so numberless are its forms and hues, that it may with all truth be said, for every face one may be chosen which shall combine the maximum of comfort with the best of taste. Any lady may have a bonnet which is both becoming to the wearer and a real protection to the head, and yet be in the fashion.

There still remain two subjects connected with clothing which demand a brief consideration. One of these is the regulation of dress to suit various ages. Of the coverings necessary for the grown-up person and the elderly, enough has been already said. In the case of infants, the mistake generally committed is to put on too many clothes composed of too numerous separate articles, and of unsuitable materials. Infants should be clothed as nearly as possible exclusively in flannel, as little as possible in cotton. The clothes should be sufficiently loose to permit of free play of the lower limbs, as it is in this manner that the child exercises its muscles preparatory to walking. In delicate children, and under some conditions of ill health, the flannel binder may be advantageous. An active and strong child causes it to wrinkle up and become uncomfortable, and it may be early dispensed with in robust infants certainly, provided a flannel shirt and flannel gown are used as they should be. As infants become older, short sleeves, leaving much of the arm uncovered, and low-cut dresses, exposing the neck and shoulders, are unsuitable in winter. How-

ever prettily these exhibit plump limbs and shoulders, they are frequently the direct cause of colds.

It is a most important matter to adapt our clothes to suit the changing seasons. In autumn, winter, and spring, some addition is needed when we go out of doors, in the form of an over-garment. No one part of the body should be over-loaded with extra clothes, to the exclusion of others. Thus, a fur cape is very well if worn in addition to a jacket, on a cold or raw day, but not alone over the indoor dress. In like manner, the throat should not be muffled up too much. If this be done, the delicate organs of the voice are rendered tender and sensitive, and more apt to suffer from accidental exposure. Outer garments, too, should permit of free use of the arms, and not pin and truss them to the side, as some shapes of ladies' cloaks do. In church, or any crowded place, the cloak, cape, or greatcoat, should if possible be taken off, at any rate, should be thrown open, so that when again closed on coming out into the colder air, its protective effect may be fully experienced. To a neglect of this, and sitting in damp clothes, colds caught in such places are (draughts of air excepted) mainly due.

The subject of household arrangements is a wide one, and, indeed, so comprehensive, that it would require many lectures to deal with it in an exhaustive manner. It might include not only such topics as the choice of a house, the mode in which it should be furnished, painted, or papered, and the plan on which the daily life of its inmates should be conducted, but also many and various ramifications into which the consideration of these matters would lead one. Such a duty if not impossible, would be possibly impertinent, and could scarcely be made to suit even the various grades of working-men for whom, though not exclusively, these lectures are perhaps mainly intended. Still, so much scope does this branch of my subject manifestly permit, that I may select a few points whereon to offer a little advice, or to make some suggestions which have been forced on my notice.

It will be at once admitted, that within the last fifty years, even within the recollection of many here present, a great change has come over people's habits. With our higher civilization, and

particularly with our vastly increased modes of communication, the country has been brought in many ways nearer the town, not perhaps in all instances to the advantage of the former. This communication has levelled down many of the differences of life, of character, and even of language, which existed till recently in parts of the kingdom not remotely separated from one another. With civilization and a larger circulation of money, wants, too, have increased, and many things which were a generation or less ago, either unknown, or articles of luxury found solely among the wealthiest classes of the community, are now indispensable in a working-man's house. Indeed, it may be said, that a working-man of the present day, who is industrious and sober may have comforts and elegancies which were beyond the reach of the nobles of a century back.

It was probably from motives of precaution in unsettled times, so that houses might be as closely packed as possible, and thus more easily defended, that the plan of living in flats, accessible by a common stair, came first into use. Perhaps, too, our frequent communication with France, where the same system prevailed, led also to its introduction ; but be that as it may, the arrangement of houses on this system has with some drawbacks, so many advantages that it will likely continue, and indeed has even been adopted in London to a small extent of late. While this plan does not admit of the same degree of privacy, which the small self-contained brick houses do which one sees making up whole towns in Lancashire, it somewhat lessens that wearisome uniformity which renders each street there the exact counterpart of another, and does not spread the buildings over such a large area. Where the members of each flat can realise and act on the supposition that each common stair might be regarded as the joint-residence of one large family, and are willing to give and take, and to fulfil, to the best of their endeavours, the golden rule, all would proceed smoothly and harmoniously. There is too often, however, one or more discordant elements, and these serve to disturb the amicable relations of all. If by any means lands could be jointly taken, and families who are acquainted culd live in the same stair, there would be more happiness in

each individual house; and perhaps fewer flittings on each term day, with the toil, discomfort, and positive destruction of property which each move entails. It is not always possible to choose the house, not even sometimes the locality, in which one would best like to live; but a house, as far as can be dry, airy, and well-lighted, should be selected. I wish it were possible to do away with area houses altogether. There are still too many area-flats occupied as houses. To some, little exception can be taken, others are merely darker than is wholesome, and we have seldom too much sun, for the greater part of the year at any time, or even in any aspect; but others, besides being dark, are damp and ill ventilated. In these the mother and the young children are the greatest sufferers; the husband and older children are enough out of doors to counteract, in some degree, the noxious influences of such dwellings. At the same time much may be done by cleanliness, white-washing, and the admission of air on dry days to lessen the evils of such under-ground abodes.

Great improvement has taken place within easy memory in the lighting of houses. Under the restrictions of the odious window-tax, and in consequence of the poor quality and high price of glass, light was admitted scantily and sparingly by means of small, deep, and dingy apertures. These had either no, or but very defective, arrangements for permitting their being opened. And hence the houses of all classes, but particularly those of a poorer description, were close and ill ventilated. That more ill health did not in consequence prevail is certainly remarkable; but the ruder habits made the inhabitants less sensitive, and they suffered less because their nerves were not so highly strung, and, may I add, because they drank less tea. I am not one of those who regard the introduction of tea as by any means an unmitigated advantage. Its immediate effects are undoubtedly refreshing and invigorating, but its more remote ones are perhaps increased liability to illness. The teapot has its place, and from that place I do not desire to dispossess it; but it should certainly not be constantly, nor even very often, on the hob. Probably once a day is often enough for most people to take tea. But I have wandered from my subject, seduced therefrom by the China

leaf. On the question of lighting and the admission of fresh air into houses, there is still room for improvement, yet matters are certainly better in this respect than they were a generation ago. Should windows be kept open at night? In summer there is little risk, provided the weather is clear and the window is open from the top, and no direct current comes down on the bed. But in winter, spring, and autumn care must be exercised in regard to this. In thick foggy weather the window must be closed, as the admission of raw damp air, laden with smoke in towns, is certainly deleterious.

Professor Maclagan has so fully dealt with this question of ventilation, that any remarks of mine savour of works of supererogation. I must impress on you, however, the necessity for caution in opening the windows of rooms at night, in which young children or old people sleep, as these are specially susceptible to the influence of cold night air.

The material of which window blinds are made is not a matter of indifference. Of all blinds venetian are the best, as the amount of light, up to almost absolute darkness, can be very simply and easily regulated. Originally these were invariably painted green, many other shades of colour are now employed; but it is doubtful if any one of these is so comfortable and grateful to the eye within the house, or looks so refreshing when viewed from without. We can look for a short time with pleasure into the blue vault of heaven on a cloudless summer day, but nothing so rests and cools the eye as to gaze on verdant fields and stroll or sit under the shade of the green leaves of the forest. If venetian blinds are not obtainable, there are many cheap and excellent substitutes. Blinds made of green worsted or cotton, or some of the grey mixtures so common and so tidy. Yellow or buff and red blinds are glaring. White ones soon dirty, and admit too much light. Where there is a necessity for partially obscuring a window, cane screens are the prettiest and best, and while admitting ample light add much to the appearance of a house from the outside or street. Another mode of preventing over curious neighbours from seeing more than is desirable of the internal domestic arrangements, is to have flowers outside or inside the window. I can quote the high

authority of Lord Rosebery in support of this, as expressed in his very suggestive opening address to the present course of health lectures. I believe we cannot tend flowers, or cherish domestic pets, without being the better for it. The act of kindness, whether this be manifested to a human being, to one of the lower animals who are dependent in their tamed state on man, or to a flower in tending and watering and dressing it, reacts on ourselves and mollifies and softens our own nature. Flowers then on the window sill, ferns or aerial plants hung from the ceiling above the window, cages with birds occupying more or less of the centre are all useful as well as ornamental. Children who are trained at home to be kind to the domestic pets, and who see how tenderly these are handled by their parents, are less likely to ill use other dumb animals with which they may be brought in contact when they go out into the world, and horses, cattle, and sheep would fare better were this training more universal at home.

The walls of the rooms must be painted or papered. Where these can be painted with oil there is so far an advantage that this can be washed down without being harmed. Certain parts of the wood work must be so painted, and when this requires renewal, a time should be selected for doing it when the children, if there are any, can be sent out of the way, or at least can be put into another apartment than the one which is to be painted. Paint when drying gives off peculiarly irritating fumes, due to some decomposition or oxidation of the oil. These act injuriously on many persons, but particularly on children, causing feverishness, sickness, and other disturbances of health. The size in whitewash is also harmful, but perhaps not to the same extent as oil paint. Of all coverings for walls, however, the most generally applicable is paper. The colour of the paper-hanging should be a subdued one, and the pattern such as will harmonize with the size of the room, its furniture, and with the purpose for which it is to be used. A paper should be selected from which the colouring material does not easily rub off, and which does not contain arsenic. It is a mistake to suppose that only green papers are arsenical, or that all greens are so. When a room is being papered afresh, the old paper should invariably be removed before

the new one is put on. Besides being dirty, the accumulated paste decays, and then smells badly. To remove the old costs a little trouble, bnt this is made up in the greater healthiness of the house, and the smoothness with which the paper adheres to the walls.

Only in this country has the system prevailed to any extent of covering the entire floor of a room with carpet, and this is a comparatively modern innovation. Such a plan has been thought to render an apartment warmer. It deadens sound more than when the wooden floor is left more or less uncovered; but I believe it has no other advantage, and has many drawbacks. The fashion of staining and varnishing or spreading with wax-cloth a space round the sides of the room while the centre alone is carpeted, has much in its favour. It allows of the carpet being much more frequently and easily lifted, and shaken or beat. And thus dust which is unwholesome, cannot collect to such a degree beneath it. Heavy articles of furniture do not need constantly to be moved, and when not in actual contact with the floor, can have the dust easily swept from underneath. Smaller carpets can be used, those can be reversed in various ways, so that they wear more equally, and rooms are rendered airier, more free from dust, more healthy, while economy, an item not to be neglected, is consulted.

In the matter of furniture a change too has taken place for the better. The huge four-posted bedstead with its canopy and curtains, which had held its own as an indispensable article for centuries, and was the admiration of all duly constituted matrons of even a generation ago, has vacated the not inconsiderable space it so amply filled, never probably to return, and if it has left a blank it is one which can be better filled. In the house of the working-man too the box beds are seldom seen, except in the wilder districts of Northumberland, and the more outlying parts of Scotland. At all events they are not now made. Iron and brass and even nickel-plated bedsteads, neat, clean, airy, and occupying less room, have replaced them both, not without some regret on the part of the housewife. The comparative privacy which the well drawn curtains, or the closed wooden shutters of

the box bed gave, compensated, it was thought, for the closeness and darkness which obtained within. Feather beds too have happily disappeared, and hair mattresses, or one of the many varieties of spring beds have replaced these. Since economy of space in the day time is often an object, the camp bedstead is one which deserves greater attention than it has got. This is made by stretching strong canvas across a stout frame which folds up. It needs no mattress, but unless a thick fold of blanket is placed over the canvas, the occupant is apt to find it decidedly cool. This form is most useful for children's beds, since it can so easily be closed during the day, the pillow, blankets, and sheets, folded neatly up, and all put quite out of the way. It is much better than the cupboard bedstead, in which the bedding was shut up from the air all day. The place where the bed should stand is also a matter of some consequence. Often there is a recess in the kitchen into which it is meant to fit. This certainly keeps it out of the way, but has the disadvantage that the bed can only be approached on one side. Such an arrangement is frequently unavoidable. In bed, as in the daytime, the feet should be kept scrupulously warm, the head, and indeed all the rest of the body cool, but not chilly. Unless the feet are warm on getting into bed, sleep is with many almost an impossibility. When it is considered that we spend one third of our whole life in bed, attention to these points is evidently worth notice.

One change has taken place, however, which has told, in many instances disastrously, on the health and lives of all classes—a change which, in view of the immense increase of population in our towns was seemingly indispensable. This is the introduction of water as a means of removing sewage. The older houses into which these alterations were introduced were, in many cases, so built and so arranged internally as to be unsuited for them. In some at least of the more modern, common sense has not always guided the architect. In nearly every kitchen of a working-man's house there exists a sink, and down this too often all manner of refuse is put; indeed the amount of faith in the capacity of the pipe to carry off anything, seems at times all but unlimited. The

trough is frequently clean enough to outward appearance. The housewife scrubs it, empties hot water into it, and, ignorant of the corrosive action of chloride of lime on metal pipes, uses this to mask or, as it is thought, to destroy offensive smells. On close questioning, it is admitted that at times whiffs or even more decided currents of foul smelling gases issue from the perforated opening. The kitchen is in general not only the day room, but the sleeping apartment of some, if not all, of the family. The other, when there are two, is kept and furnished as a better one, with a pride, natural and not in itself wrong, which is regarded as part of the character of Scotch people. It is not unfrequently let to a lodger or two, so as to assist in making up an otherwise heavy rent. In this case, the lodger has the best of it. When refuse, be it animal or vegetable, or merely water which contains this mixed with it, is confined in close tubes and allowed little access to air, it provides a favourable soil for the growth of various low forms of life. These are of the nature of mould, or minute organisms which are on the borderland between plants and living beings. To the healthy these may possibly do little harm. The husband and older male members of the household out all day, with firm muscles and sound tissues, may and do escape unhurt, or not evidently so; but the wife, and especially the children spending unavoidably much of the day in the house, even, it may be, in the kitchen alone, and all night also in the same atmosphere, suffer more or less. We know that certainly two diseases, typhoid fever and diphtheria, and allied to the latter are many sore throats, are produced by foul gases generated in sewers and their connecting pipes. Perhaps, more properly these gases are but the vehicle which carries up some of those minute organisms which, implanted in an unhealthy or weakened body, occasion those diseases. But besides these definite disorders, there are conditions of ill-health which result from the same or similar causes, less decided and less generally recognised. Such are neuralgia, and many disturbances of the stomach and bowels. Too great care cannot therefore be taken, to avoid putting any substances down the sink, or even to wash in its trough any articles, which give off matters, which in the pipes will ferment

and rot, and cause offensive and dangerous gases. It has been said that the offensive smell does not in itself constitute an element of danger, but that it is the warning signal which if neglected, is inevitably followed by mischief. The really poisonous gases are said not to have any smell. Carbolic acid has a powerful effect in checking the production of such poisons, and a tablespoonful of the coarse acid, mixed with a bucketful of water, should be emptied down the sink several times a week. It must never be forgotten that carbolic acid is a deadly poison, and the bottle which contains it should be kept on a high shelf—well out of harm's way.

It is indeed a great pity when the family, from such causes as I have indicated, must sleep in the kitchen. When this cannot be helped, then the sink should be cleaned and flushed, and the room aired as much as possible. These gases steal like the thief at night into our houses, when the air is not much in motion or so often renewed; and we are more open to their insidious attacks, because during sleep our vital powers are lowered and our strength less than in the day, with its active, bustling life, and with its supplies of food.

We are now plentifully supplied in Edinburgh with excellent water, but this may become polluted from various errors in storing it. To one only of these allusion will be made, since it comes directly within the scope of this lecture. On inquiry, it is no uncommon thing to be told that the tenant of a house does not know when the cistern was last cleaned. It is unavoidable that cisterns, however well situated and covered, should become fouled. They must, therefore, be cleaned at stated and known intervals. Sometimes one cistern supplies several families, and a knotty question arises whose duty it is to have it cleaned. All this jealousy should be laid aside; and if the members of one family cannot or will not clean it, the others ought, and without grumbling. In so doing, they not only save themselves from a possible danger and a positive discomfort, but they read their neighbours a valuable lesson. Even indirectly advantage accrues, for were some of the neighbours' household to fall ill in consequence of the bad state of the water supply from this cause,

disease might thus be spread. Water impure from this cause—dirt accumulating in the cistern—is a likely source of those worms which infest children, and even adults, and undermine their health. In cleaning the cistern one caution is necessary—the lead lining must be treated tenderly, so as not to remove that protective coating which forms on it and prevents the water from dissolving the lead, and thus giving rise to symptoms of lead-poisoning oftener than it does. Run off the water; clean the surface with a soft brush gently, but do not scrape the lead.

The subject of food has been already so ably dealt with that I should not have alluded to it had it not been that there is one of its aspects in which it is seldom considered. I refer to the question of what may be termed "likes and dislikes." Taste in diet is capable of almost unlimited extension. We are so constituted that we can accustom ourselves to and finally positively delight in viands which at first may have been absolutely nauseous. It is in this way that it is possible for human beings to reside in almost any region and quarter of the globe, though the materials from which the necessary nutriment of the body are extracted are widely different in flavour, in appearance, and within certain limits even in chemical composition. If then from conditions of necessity, or out of choice, or by determination, we are able to alter our habits in this respect to suit our circumstances, the reverse must also be admitted. We may so cultivate a sense of repugnance for certain articles of diet, that this feeling of disinclination eventually grows and increases, till we are actually unable to eat some one or more of those substances, which are usually classed as foods. A distaste for such articles of diet as are rare luxuries, or unnecessary condiments, or sauces, is of no consequence. But it is far otherwise when we thus expunge from the list of our daily food valuable elements of diet. One, and perhaps the most important, of these is milk. Quite a number of persons cannot, or believe they cannot take milk. All sorts of reasons are alleged for this, which must be an acquired incapacity. Milk has been regarded as a model food. It contains within itself all the ingredients needed for the perfect nutrition of the infant during the first twelve months without any addition whatever,

and all attempts to produce a *thoroughly* satisfactory substitute for it have hitherto failed. Every infant takes more or less milk, and the more rather than the less, the better. If such is the case this disinclination to take milk must have a commencement some time after the earliest period of independent existence. It grows gradually and imperceptibly till it reaches that point, when the individual becomes possessed with the idea that milk is unsuitable or injurious for him or her. The earliest beginning may be mere childish whim, or perhaps medicines have been administered disguised in milk, a plan which should *never* be pursued. Be that as it may, the distaste once permitted to arise in the mind assumes larger and ever larger proportions, and may end by cutting off from habitual use an element of diet which is all but essential during the years of growth, and a valuable adjunct at all ages. This statement might have been even stronger. I have cited milk, but other common and wholesome articles share the same fate. Porridge, eggs, cheese, even butter, sugar and salt, might have been chosen for the illustration. The remedy for this rests in the hands of parents, nurses, and those entrusted with the care and feeding of infants and children. Any expression of dislike to a plain wholesome article of food should be repressed at once with *gentle firmness.* It is unwise to ask children what they would like to eat. The choice of suitable food is the result partly of habit and training, partly of personal experience, and in these children are naturally as yet defective. They should be made to understand that whatever is placed before them for food must be eaten, of course care is to be taken that proper diet is selected for them, and served tidily and neatly. They should be instructed that there are things which their elders can take, which yet are unsuitable for them. In particular, distaste for milk in its simple form, or made into puddings, or for the fat as well as the lean of meat, should be decidedly discouraged. No one can tell in what circumstances his future life may be spent, and it is no slight advantage to be able to partake without discomfort of any plain article of diet. It cannot be too strongly impressed on the mind, that inability to take particular substances, is far oftener acquired than is an innate peculiarity of constitution. Were it necessary,

other proofs of this might be easily adduced. One may offer, however, an explanation of this incapacity to take certain articles. The process of digestion is a complex one, and though in health, all the organs concerned in it act in perfect harmony, some one or other is apt at times to get out of gear, and so give rise to one of the many forms of imperfect assimilation of food, to which the general name indigestion is popularly applied. But, if from any cause our food is defective in one of its necessary ingredients, say fat or oily matter, for example, and this deficiency is perpetuated for a length of time, the gland or organ, whose duty it is to furnish those juices fitted to reduce this particular element of diet to a state in which it can be incorporated into the body not being employed, ceases to act or does so imperfectly. In this way the nourishment of the body is incomplete, and that waste which is constantly going on, is not fully repaired. Thus, the body, on the hand, loses a requisite element of its composition in whole or in part, while the power of digesting this particular substance or compound, fails from lack of exercise, and dislike to it ensues.

In connection with household arrangements, one concluding remark may be made. Economy of time is perhaps, of all things, the most important. Time is certainly more valuable than money. No money can replace time lost or misspent. We all waste time, some more recklessly than others. Method and punctuality are the two great checks on this expenditure. These, too, are valuable lessons aud priceless training for ourselves. And these exert over others a power, which acts, silently it is true, but none the less efficaciously. Let us then cultivate by every means in our power, that love of order, which springs directly from being methodical and punctual. And let us all strive to make our homes happy homes, cheerful homes, and holy homes.

THE EAR IN HEALTH AND IN DISEASE.

By R. J. BLAIR CUNYNGHAME, M.D., F.R.C.S.

The ear in health and disease is the subject of our lecture this evening, and I would just mention that, although a small organ, it is, as you are doubtless well aware, one of the most important in the body: it is one of "the five gateways of knowledge," as the five senses were so beautifully designated by the late good and gifted Professor George Wilson.

Many of us may have felt what it is to be but for a time a little dull of hearing, as when after bathing, and especially after diving, we find one of our ears to be what is called stopped up, due to the simple displacement of a little bit of wax in the outer tube of the ear; and although not *deaf*, what intense discomfort it gives rise to until the cause has been removed, either by oneself or a friend, medical or otherwise. When this simple matter causes such annoyance, what must be the feelings of one deaf, or rapidly becoming so, from disease of the ear? "Diseases of the ear are of most frequent occurrence; their consequences are often very serious, affecting the comfort of the patient, his social pleasures, his local relations, his success in business, his intellectual development, and even the duration of life." It is perhaps unfortunately somewhat true that the very frequency of ear disease, and of deafness not very severe, is apt to make any one affected, especially if there be no pain to annoy him, careless in thinking much about the matter, and just letting things take their course. This is a great mistake, inasmuch as all affections of the ear should be attended to at once, because in many cases if this is not done it may be too late when really driven to seek assistance on account of pain in, or discharge from the organ,

more especially perhaps when it becomes offensive and disagreeable to oneself and others, or when deafness more or less absolute has occurred.

The above remarks refer to all, but above all to the young, who we shall see suffer very frequently from affections of this part, more or less serious in their nature, often occurring it may be as the dregs, as it is called, of one of those common diseases scarlet fever and measles; or it may be a result of scrofula, and even a common sore throat or cold in the head is not unfrequently the commencement of dulness of hearing, which may ere long pass into complete deafness, a condition only to be mentioned to enable you to imagine the unfortunate condition of one so afflicted. Still further let us bear in mind that the consequences of ear disease may be very serious to the health, and not a few deaths every year are due to disease of the brain and its coverings, which had its origin in the ear, and which, by a little care and attention paid to the latter at an early period, might have been completely averted. As Professor G. Wilson says, "The ear is in many respects a more human organ than the eye, for it is the counterpart of the human voice; and it is a sorer affliction to be cut off from listening to the tongues of our fellow-men than it is to be blinded to the sights on which they gaze. Those who are born or who early become deaf are far more isolated all their lives from their hearing neighbours than the blind are from those who see. The blind as a class are lively and cheerful, the deaf are shy and melancholy, often morose and suspicious, and naturally so, for our interest in each other far exceeds and ought to exceed our interest in the world, and from all this human sympathy the deaf are almost totally cut off. The deaf, unless they have a great aptitude for such occupations as occupy the eye and hand, are far more narrowed in their circle of studies, and much more solitary than the blind."

Dr Kitto says in his work on the "Lost Senses," while referring to his never having heard the voices of his children, "If there be any one thing arising out of my condition which more than another fills my heart with grief, it is this, it is to see their

blessed lips in motion and to hear them not, and to witness others moved to smiles and kisses by the sweet peculiarities of infantile speech, which are incommunicable to me, and which pass me like idle wind."

Still further let us remember, if the child does not hear when young he is almost sure to become dumb, and if not so serious as this, we should consider that the training of the young mind is greatly hindered by dulness of hearing, and consequently such an one when grown up to manhood runs heavily handicapped in the race of life against his hearing opponents.

We may look upon this subject from another, and perhaps more selfish point of view, inasmuch as all may suffer indirectly from the deafness of others. How many railway accidents may be traced to the fact of an engineman or pointsman being hard of hearing? During 1881 there were in Great Britain 170 collisions between trains, causing death to 27 persons, and injuries to 898, and as the newspaper from which I got the above figures adds, "None of them were of that terribly fatal character which sometimes belongs to accidents of this nature." During the same period 32 passengers were killed when crossing railway lines, and 117 servants of the railway met with their deaths while walking, crossing, or standing on the line on duty; now probably many of these unfortunate persons were more or less deaf. Again, and with more exactitude is the result of the examination made by Drs Lehfeldt and Pollnow of Berlin as to the hearing powers of 160 of the servants employed on one of the Prussian railways, and who found that of this number 34, or more than 21 per cent., or one-fifth of the whole, were more or less affected in respect to their hearing.

Some go the length of saying that few persons escape deafness, and that not many above fifty years of age have their hearing perfect, which is probably not far wrong.

With this introduction let us now pass to the consideration of the anatomy of the ear, after which we will devote a few words to the physiology of sound and hearing, and then pass to the diseases of the ear.

The organ of hearing exists in many of the sub-kingdoms of animal life, in the lower forms being but a simple little organ which enables the possessor only to hear sounds; as we ascend the scale the ear becomes more and more developed and complex, until in the mammalia it has become perfect. In the crustaceæ, as the lobster, the ear consists of a little sac or bag, situated at the foot of the first joint of the smaller antennæ or feelers, it contains a few fine sandy particles, and has the nerve of hearing spread out upon its walls.

In fishes generally we find the vestibular sac present, with, in the higher classes of them, one or more of the semicircular canals. In reptiles, as lizards and serpents, in addition to these we find the small ear bones to have appeared, and a cochlea or snail shell-like bone of simple form; in birds the parts are still more developed and complex, till in mammalia, as we have said, the organ is complete.

In man the ear may be described as consisting of two parts—(1) a conducting apparatus, or the outer and middle ear, and (2) the perceptive part, consisting of the inner ear.

The former consists of (*a*) the auricle or ear of common language, and (*b*) the external auditory meatus or auditory canal, or the outer tube of the ear, which leads from the auricle down to (*c*) the tympanic membrane or drum head. These parts are easily seen, and can be examined and manipulated by the surgeon. Behind the drum head we find (*d*) the tympanic cavity or the middle ear, with (*e*) the ear bones crossing it. (Fig. 1). These various parts receive the sound from without and convey it to the interior or inner ear.

The auricle or ear of ordinary language is in shape roughly that of a funnel, more so, as you know, in animals than in man; it is composed of cartilage or gristle covered with skin. The lobe or lower part is composed chiefly of fat, and usually contains no gristle, an important fact especially to those of the female sex who have their ears pierced for wearing ear-rings, usually a simple operation, and causing no pain or disturbance after the puncture is made, but if, as sometimes happens, a bit of gristle is

in the lobe and is pricked, inflammation is set up and great pain ensues.

The auricle varies much in size and shape in different persons, and may, like the nose, be a family distinguishing point; and a Frenchman goes so far as to say, "Let me see your ear and I will tell you who you are, where you come from, and where you are going." When well-formed and symmetrical the ear is a beautiful addition to the head and face, and Lavater, the great physiognomist, said, "that a white pliant ear of symmetrical and elegant form, with faultless lobe of becoming size, which is nicely attached to the head, can belong to no mediocre individual."

The use of the auricle is to receive, reflect, and condense or intensify sounds which come upon it. This we are constantly proving in our own persons, as, when listening intently to a sound, and especially to a distant one, the hand is placed behind the ear, and that for two reasons, one being to increase its size, and the other to bring it forwards toward the sound, doing with our hand what the lower animals, not having hands, manage by moving the ear itself by means of its muscles. At the same time, the presence of this part is not absolutely necessary for hearing, as it has been cut off as a torture among Eastern people, or lost by accident, and the hearing of the individual so mutilated has not been materially affected. It also affords protection to the inner parts of the ear, and assists in preventing the entrance of dust, insects, &c.

Among savages the ear is a part of the body often disfigured by so-called ornaments, as wearing in them large and heavy ear-rings, which elongate the lobes, and some go so far as to keep various articles of use in slits made for them through different parts of the ear, probably, I presume, not having pockets for holding such, their clothing being but scanty.

Some birds, as the turkey, can stop their ears at will by a kind of valve on the outside, and aquatic animals draw the auricle tightly over or into the opening of the ear, and so prevent the entrance of water when swimming under the surface, a matter in which man should imitate them by putting some cotton wadding into the orifice of the meatus when bathing.

The second portion of the conducting apparatus is the external auditory meatus, or the external tube of the ear leading from the auricle and surface of the side of the head to the tympanic membrane, the so-called drum head. This tube is about one inch

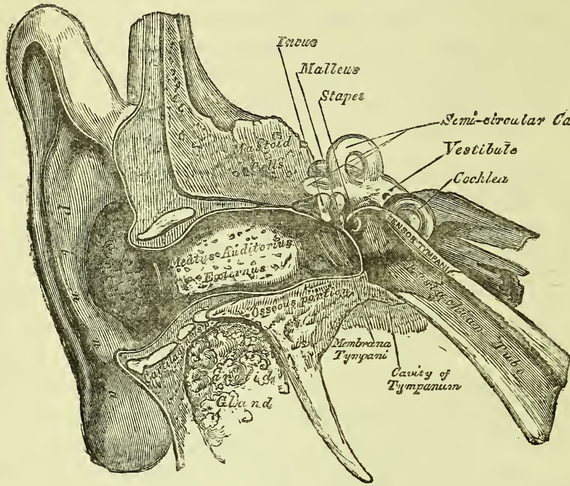

Fig. 1. A front view of the organ of hearing.

Fig. 1 presents a view of a section made through the ear, showing the various parts in position, the auricle—external meatus, or outer tube of the ear, the tympanic membrane or drum head, the small bones, the semicircular canals, and cochlea, with the Eustachian tube.

in length, and is covered with skin, in which we find glands (1000 to 2000 in number) like the sweat glands on the surface of the body, and for the purpose of secreting or forming the ear wax. Towards its entrance hairs grow, evidently for the purpose of guarding the opening against the entrance of things from without. The outer half of this tube is soft and gristly, the inner or deeper half is bony. Now this is important, for as we shall see, children, and even their elders, sometimes put things into their ears, and when, say, a pea has been put in, but little pressure is required to force it deeper, and when past the outer soft half of the tube, it is more difficult to get out, being naturally jammed against the hard walls.

We now come to the drum head or tympanic membrane, (fig. 1), situated at the deeper end of the external auditory meatus, and which separates the middle ear from the tube, and consequently from the air.

The drum head is a little circular membrane or curtain, not unlike gold beater's skin in appearance; it is fastened all round at its circumference to the bone, just as a watch-glass is in its frame. It is easily seen by the surgeon, and its appearance under different conditions is of the greatest use to him in discovering what is the matter with the organ of hearing behind it. Attached to its inner surface is, as we shall see, one of the small bones of the ear.

Beyond it is the cavity of the tympanum, or the middle ear proper (fig. 1). This is a space about the size of a bean, filled with air, and across it passes a chain, as one may describe it, composed of three little bones, one end of it being attached to the drum head, the other to a small foramen or aperture which leads into the inner ear. These bones are the malleus or hammer bone, the incus or anvil bone, and the stapes or stirrup bone, these names being given from the supposed resemblance they present to those three well-known objects. These are joined to each other by little joints, and are so able to move, a most important fact, inasmuch as their becoming fixed, as sometimes happens in diseased conditions, is a cause of deafness. Besides these joints, these bones are provided with certain small muscles, which, by their contraction or relaxation—as you will remember Dr Cathcart explained—enables them to regulate the tension of firmness of the drum head, as also of

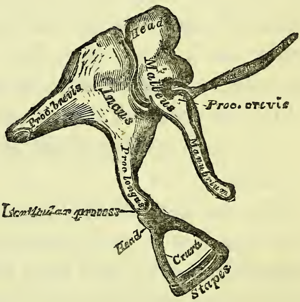

Fig. 2. The small bones of the ear.

The three small bones of the ear, in the position they occupy in the ear — malleus or hammer bone, incus or anvil bone, and stapes or stirrup bone.

the membrane which fills up the opening into the inner ear, and to which the stirrup bone is fixed.

Another important thing in connection with the middle ear is a tube which leads from it to the back of the throat—the Eustachian tube (fig. 1), by means of which air is admitted into this part of the ear, and so provides for the pressure of it being the same on both sides of the drum head, an important point, besides which it gives the cavity a distinctly resonant character. You can easily prove to yourselves the action of this tube; by holding your nose between your fingers so as to close the nostrils, shutting your mouth tight, and blowing, you will or should at once feel the air rush into the ears, and perhaps cause a dullish rustling sound, or even a crack, due to the blowing outwards of the drum head. This has probably not improved your hearing for the nonce, because the pressure of the air upon the inner side of the drum head is greater than on the outer; it is, in fact, compressed air, but on making the movements of swallowing two or three times, you are aware that the air is leaving the cavity again, being sucked out as it were, and the hearing becomes again as it was, the drum head having resumed its former position. This tube is most important, inasmuch as its closure, which is common, is, as we shall see, a great cause of deafness, and what is as important, if attended to soon enough it is usually curable.

Having now shortly described so far the anatomy of the ear, I would say a few words about the physiology of hearing and sound, in order you may the more readily understand the use of those parts we have been considering.

Now what is sound? We may call it "vibrations appreciable to the ear." Physicists or natural philosophers have shewn that the cause of sounds we hear are "vibrations communicated to the particles of air in the neighbourhood of a sounding body. From these it passes to other particles in the neighbourhood, and from these to others still further away from the source of the sound or noise, until the waves of sound, as they are called, strike upon our ears, and we perceive them. This has been

aptly likened to the ripples caused by a stone thrown into still water, which gradually spread from the spot where it entered the water, or to the undulations seen upon a field of wheat when the wind blows over it. The stalks do not pass on, but they each have a certain limited movement to and fro, which helps forward the progress of the wave; and in a like manner the individual particles of air, if we can so call them, push onwards the sound waves, although their own movement is but of small extent.

"All bodies, solid, fluid, or gaseous, are capable of conveying the appreciation of sound to our ears, and it is also certain that the presence of some such body is absolutely necessary for the purpose. This we can prove by placing any sounding body, *e.g.*, a clock, under the bell glass of an air-pump. The sound is heard distinctly, but commence to exhaust the air, and it gradually becomes fainter and fainter as the air leaves the glass, until at last it is not heard at all, although you see the works going all the time; and on letting the air in again, the sound as gradually returns."

Again, you also know, I daresay, that the denser or heavier the air, the better sound is conveyed, *e.g.*, on a cold, still day, a conversation can be carried on at long distances apart, even to a mile in Arctic regions, we are told; and, on the other hand, at high elevations, where the air is thin and light, the voice must be raised when speaking to one even close by.

With this short explanation we are now ready to comprehend the use of the various parts of the ear we have already considered. The outer tube having collected the waves, or oscillations, or vibrations, from whatever source they may have come, directs them down to the drum upon which they impinge or strike, and into which they, as it were, pass, and from it are sent on through the chain of small bones to the oval aperture into the inner ear previously mentioned, where at present we shall leave them. (I., Fig. 3.) Now, from the shape of the drum head, which is slightly funnel-like, these vibrations are intensified at the centre, *i.e.*, the spot where the handle of the hammer is fixed to it, just

as water when poured through a funnel runs more rapidly as it gets into the narrower part of the funnel, and it is proved that on account of this, as also of the lever-like action of the small

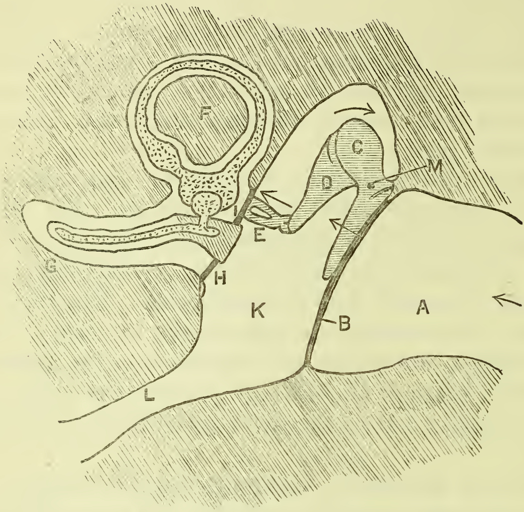

Fig. 3. Diagram to explain the passage of the vibrations from the outer ear to the oval foramen.

The vibrations or waves of sound pass down A, the external auditory meatus, and impinge upon B, the tympanic membrane or drum head. They then pass through the three bones, C, D, and E, the hammer, anvil, and stirrup bones, to I, which is the oval foramen opening into the labyrinth. The arrow heads explain how the bones move. The hammer bone, C, is fixed, as it were, on a pivot at M, whilst its long arm is attached to the drum head B. Consequently, when the latter moves inward, the lower part moves with it to the left, while the head or upper part of the hammer bone moves to the right in.the direction of the arrows, and in consequence D, the anvil bone, with E, the stirrup bone, move to the left, and so press upon I, the oval aperture. The reverse of these movements take place when the tympanic membrane is drawn outwards towards A, the external auditory meatus. I is the oval, and H the round foramen; F is one of the semicircular canals, and G the cochlea (unrolled), both in section; K is the tympanic cavity, and L the eustachian tube.

bones, the force of the vibrations or sound waves which pass onwards through or by means of the latter, is increased to twenty or even thirty times by the time they reach the oval aperture. (I., Fig. 3).

Now, what is this apparatus but a telephone, and the waves or vibrations are conducted along it in exactly the same manner as they are along the string which connects the two cardboard

discs covered with parchment—the toy telephones which were sold in the streets by hundreds for one penny.

Sounds vary much to our ears—they may be high or low, shrill or deep, and this is due entirely to the number of, and rapidity with which, the vibrations that are set up strike upon the ear.

According to the philosopher, very low sounds may be caused by only 8 vibrations per second, while very shrill and high sounds, which cause pain to the ear, are caused by as many as 36,500 vibrations per second. We may more easily understand this when we are told that "in organs and pianos the vibrations vary from 33 to 4224 per second, and when these are regular, and with equal and even intervals between them, the sound is a musical one, but when irregular, the sound is discordant, and simply a disagreeable noise is produced.

We now come to the second great division of the ear, viz., the perceptive portion, or the inner ear, that part which is in direct communication with the brain by means of the nerve of hearing, and to which the vibrations have been conducted by the parts just described. This inner ear consists of several most complex and delicate structures (hence being named the labyrinth) which are deeply hidden within, in fact, are excavated out of one of the hardest bones in the body, in order they may be as safe as possible from harm from without, because any, even a slight injury to this part completely destroys the sense of hearing.

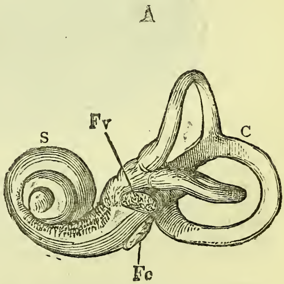

Fig. 70, A.

Fig. 4. Inner ear.

S, cochlea or snailshell bone; C, semicircular canals; Fv, oval foramen; Fc, round foramen.

Speaking generally, it consists of a series of cavities differing in shape, channelled out of the solid bone, and communicating with the middle ear by two small apertures or foramina as they are called, the oval and round ones. You will remember that it is into the former of these, or rather into the membrane which covers it, that the foot of the stirrup bone is fixed. (I., Fig 3.)

These cavities are three in number. A central one or vestibule or entrance, because the other two open into it, this lies alongside the tympanic cavity, and passing off from it towards the front is the cochlea or snail shell bone, and towards the back we find three bony canals, called semicircular from their shape. They run almost at right angles to each other. (Fig. 4).

Inside the various parts of this bony case is fluid, in which floats a soft or membranous cast or mould of it, as it were, and this in turn is filled with fluid, which is just a part of that which naturally exists in the brain. Upon the soft cast the nerve of hearing ends in very delicate fibres, and it is to this that the vibrations we followed to the end of the chain of small bones are finally conducted, and by means of this nerve the brain is made aware of sounds. These vibrations or oscillations are

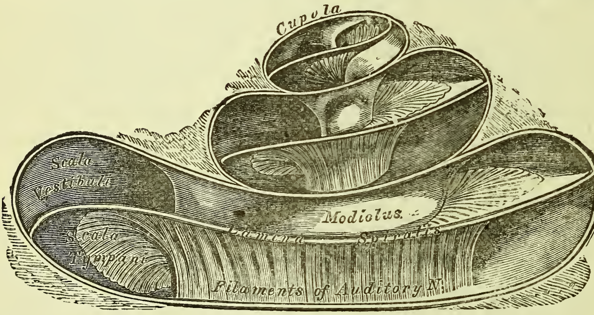

Fig. 5. The cochlea laid open.

In fig. 5 we see the cochlea laid open to shew its structure, which is like that of a snail shell composed of two and a half turns. The spiral cavity is divided into two all the way up by a partition, partly bony and partly soft, lined by the before-mentioned membranous cast, and it is on the soft part we have the nerve of hearing ending in very fine filaments or threads, which apparently terminate in very minute cells.

transmitted through the oval aperture (fig. 4, Fv) to the fluid within the labyrinth, where they in turn cause a similar condition in it, waves, in fact, which are transmitted to the various parts of the interior of that cavity, viz., into the cochlea or shell-like bone and semicircular canals, where they beat upon the minute ends of the nerve of hearing, which terminate in these parts, acting, in fact, like little hammers tapping those ends, causing them to react,

as it were, and sending on the message to the brain, where cognizance is taken of it, and sounds are really heard. (Fig. 5). The object of the second or round opening into the vestibule may now be readily seen. It, like the oval one, is covered by a membrane, and you will at once understand how this prevents injury being done to the delicate nerve ends by the shock of the vibrations or waves in the fluid; it acts as a valve, so to speak, in relieving the pressure, just as when a glass tube is full of fluid, the ends being closed by a membrane, you tap one end the other bulges out, and so prevents excessive pressure being made on the inside wall.

Such is a sketch of the structure of the human ear, and of the physiology of hearing.

We now pass to the DISEASES of the ear, and first those of the *auricle.* This part is not at all unfrequently found to be almost flattened against the head, the ridges and hollows of its surface much obliterated, and the opening into the external tube considerably diminished in size. This is caused by pressure upon the part as by bonnet or cap strings. It interferes with the free entrance of sound, and prevents the proper escape of wax, and is also awkward when the ear requires to be examined, or has to be syringed, the narrowed opening preventing a free view of the parts within. Therefore, do not wear anything over the ears which *presses* upon them.

Growths may occur in the ear due to the custom of wearing ear-rings, and especially when those are of brass or base metal, although gold ones sometimes give rise to the same. Such may become troublesome, and then require removal by the surgeon's knife.

You may remember we stated in an earlier part of this lecture that smart *inflammation* may be set up in the lobe after piercing it for the wearing of ear-rings, should a portion of gristle be there and happen to be transfixed by the needle, and all the more likely should that be a dirty or rusty one. If this occurs the best thing to do is to bathe it well and frequently with hot water, in the hopes that the swelling, &c., will go down; if not, it

will probably suppurate, and will require to be opened by a prick with a knife.

Frost bite may affect the ear even in this country during a hard winter, as the ear is an exposed part of the body and not often wrapped up, and the flow of the blood through it, although ample, as is well seen when it tingles after exposure to moderate cold and is quite red, is not so strong as in other parts which are nearer the heart, the centre of the circulation. When exposed to cold the ear becomes chill very soon, and if the cold be excessive it really may become frozen, appearing white and dead-like, and without any feeling in it. In such a case heat or even warmth should not be applied, else what the doctor calls reaction be set up too rapidly, *i.e.*, the blood returns to it too quickly and in too great quantity, and inflammation ensues, with an almost certainty of the whole dropping off from mortification. In such a case gentle friction with a cold hand or snow or ice is the proper treatment, until the white and dead-like look of it is passing away and some feeling is returning in it, in fact, actual pain.

A *blow* on the ear may cause a great swelling of it, quite altering its shape and appearance, due to the escape of blood into it beneath the skin. This is often seen in pugilists, and is not unfrequently to be noticed in one ear at least of the statues of the ancient Greek and Roman gladiators and athletes, showing how true to reality were the great sculptors of old. Such a condition of course requires a visit to the surgeon, otherwise the ear may be malformed for the remainder of the individual's life.

One form of skin disease, *eczema* or *tetter*, frequently attacks the ear, and when of long standing alters its shape and appearance, besides which it is a painful affection and apt to become chronic. The ear when so affected is red, sometimes moist, at others dry, very itchy, and rubbing or scratching tends only to increase the inflammation and cause the extension of the disease into the external meatus, down which it may pass and ultimately be a cause of deafness. In the early stage, cleanliness, washing with soap and warm water, and the use of some simple ointment, as vaseline or white zinc ointment, applied so as to prevent the

air getting at the affected surface, is probably all that is necessary. When it is more chronic you had better consult your medical attendant.

Pulling the ear, which is not unfrequently done as a punishment to young people, should not be indulged in, as injury may thus be done to the ear and to the outer tube which might have a life-long evil result, or inflammation may be set up in the tissues about the ear. Even disease of the bone to which the ear is attached might in a delicate child be thus induced.

Diseases of the external meatus or outer tube.—Wax or cerumen is a pale yellowish, rather fluid substance, chiefly fatty, which is gradually formed in the same way and by the same structures—glands—as you were told in the lecture upon the skin the sweat was. The wax is only a little thicker, and formed in less quantity.

Deficiency of wax is by many considered a serious thing and a cause of deafness, but not so. It is but seldom a complete want of this exists, and when so, it is due to some other affection of the organ, especially when the eczematous inflammation before mentioned extends into the tube, and causes a dryness, with at the same time itching; and once and for all allow me strongly to impress you with the fact that picking of the ear for this or anything else, as with a pin, toothpick, &c., is very bad, and often the cause of great injury being done to the ear, and even to the drum head, which may be followed by deafness. There are two cavities in the body into which pins should not be put, but into which they too often are, viz., into the ear and mouth. Avoid both.

Excess and hardening of the wax.—When formed in normal quantity it does not accumulate, but is gradually thrown out of the ear in little masses. Sometimes, however, this does not take place, and it collects, becoming dry, hard, and brown in colour, and gradually fills the tube, its exit not having been hastened by the picking it has probably endured, but quite the reverse, this only serving to push it more firmly and deeply in. As long as the tube is not quite filled up it may cause wonderfully little discomfort, but all at once the little chink which is until now left is

filled up, or the plug is pushed down upon the drum head, and deafness at once occurs, because the latter can no longer vibrate with the waves of sound entering the meatus, and it is perhaps accompanied by singing in the head, giddiness, and pain in the ear. When this takes place the individual may consider himself suffering from disease of the brain, when all the time these horrid symptoms are caused by the stirrup bone pressing upon the oval aperture, and vanish at once when proper steps are taken to relieve the cause. This, as you may imagine, is to remove the wax, and for doing it the syringe and warm water alone are the proper things. Of course, before syringing, the ear should be examined and the wax seen, as the above symptoms may be caused by other things than this, and the ear would then not be improved by having a stream of water forced into it and coming rushing against the drum head. A little glycerine and water, or soda in water, dropped in for a night or two are often useful to soften the wax, because it is sometimes very hard indeed, and so permits of its more easy removal.

Foreign bodies frequently find their way into the ears, being either put there by the person himself, as buttons, peas, beans, shells, slate pencil, &c., or may gain access without the permission of the owner, as insects. Sometimes most extraordinary things find their way in, and it was only the other day I noticed in one of the medical periodicals the case of a lady who had suffered much from deafness and throbbing in her ear, and on consulting a doctor he saw a black mass at the bottom of the meatus, which, on removal, he found to consist of a carpet tack, embedded in a mass of clotted blood, wax, and cotton wool. It had been there the patient did not know for what length of time, but for years. This case exemplifies how long suffering nature may be before she resents such a liberty, and at the same time how, when she can stand it no longer, what suffering may result.

Foreign bodies are most frequently put into the ears by children, many of whom have a peculiar pleasure in stuffing small things they pick up into these apertures, or up their nostrils, and is a practice against which they should be cautioned. Now, as a rule,

anything that is put into the ear will come out again when properly treated, but it is most usual in such a case for the mother or nurse when she finds what has happened to endeavour to get the thing out by picking at it with a hair-pin, or other small instrument that may be at hand. You may remember, the outer half of the external tube of the ear is soft and slightly dilatable, the inner half, passing through bone, being hard and resistant, so that the usual result of the endeavour to remove a bead for instance, is to push it in beyond the soft part, where it becomes fast lodged, and soon causes great pain and inflammation. In such a case the proper thing to do is, as with wax, use the syringe. As this little operation is not a severe one, but to be effectual requires to be properly done, let me describe how to perform it. Fill your syringe—a four or six ounce one is best—with warm water, *but not too hot;* take hold of the upper part of the auricle between the thumb and forefinger of the left hand, and pull it gently upwards, by which means you straighten the tube of the external meatus; then place the nozzle of the syringe which is in your right hand just inside the opening into the meatus, and inclining it towards the upper or under part of the tube push down the piston gently, when the water rushes in, and in the great majority of cases gets behind the foreign body and washes it out. If after two or three syringefuls you do not succeed in your desire, try no more, but go to your doctor for assistance, not putting off time, or pain and irritation may be set up, and then the removal will be a much more serious thing.

Insects may get in, as when one is lying on the grass during a warm summer day, and they usually cause great pain by their moving about; but remember they cannot get farther in than the drum head, which prevents their passing into the middle ear, and there is no possibility of their getting into the brain, as is so often imagined and dreaded. The best way to get rid of such an intruder is to fill the ear with water or oil, when he will generally at once back out, or if not, a syringeful of water will wash him out.

Inflammation of various kinds, or rather varying in its seat, may affect the meatus, but we shall only mention one form, viz.,

that of boils, which are by no means uncommon, and are, when present, extremely painful. In this as on other parts of the body several usually occur one after the other. They are frequently the result of the constitution of the sufferer getting below par, or may be due to some cause or other from which he is alone to blame, as exposure to cold. These boils are very small, as a rule, but cause excessive pain in the ear on account of the inability of the parts in the tube to permit of swelling, which is a result of the inflammation about them, and the pain is intensified on pulling or moving the auricle. When this inflammation extends down to the drum head the pain is much increased by coughing, swallowing, etc., which cause movement and pressure upon it from the air passing up the Eustachian tube. The boils may or may not be able to be felt by the tip of the sufferer's finger, this depending upon whether they are situated near or distant from the orifice. To ease the pain, the best plan is to fill the ear from a tea spoon with water as warm as can be borne, and to keep emptying it and refilling it every few minutes; the water cannot get farther in than the drum head, which, you know, closes the bottom of the tube. Another plan is to place a sponge against the ear which has been filled with hot water and squeezed till only steam is left in it. What you should avoid is the application of poultices, as when boils are present such seem to favour their recurrence. Should the above not suffice, the doctor had better be summoned, who will with a very fine knife make a little cut into each boil, which at once relieves the pain, especially if it bleeds freely. Deafness and noises in the head usually attend the presence of boils in the external meatus.

Neuralgia often occurs in the ear, and is accountable for the loss of many a good night's rest. This, with the last, come under the familiar designation of earache, but they are vastly different as to their cause. Here we have no local inflammation, but irritation to some of the nerves of the ear, and generally not at the spot of pain but at a distance; it may be from a bad tooth, or it may be due to the health being decidedly low, when the neuralgia is but a sign of this, and is cured by the use of proper food and other remedies. As a rule there is no deafness or noises

in the head, and if a tooth be the offending cause, I recommend a visit to the dentist.

Proceeding deeper, we sometimes find *the tympanic membrane inflamed,* a condition that occurs occasionally after bathing and diving when the cold water has gained access to the ear, especially in those who have a large and straight tube; and bearing this in mind it is a proper precaution to guard the ears when so employed by placing a little bit of cotton wadding in them, which will prevent the free entrance of water. As before mentioned, when the drum is inflamed the pain is increased by coughing, sneezing, swallowing, etc.

The drum head is sometimes injured or ruptured by its close exposure to sudden loud sounds, *e.g.*, the firing of heavy ordnance, or even of a gun when close to the ear. Another cause is being in compressed air, as may happen to those employed in sinking the piers of bridges, where air is used to expel the water from the cylinders. Blows on the side of the head with the palm of the hand may do the same, as also other injury should the ear be unsound at the time, which form of punishment, therefore, never apply to a child, but if such be absolutely necessary, and I do not really think it often is, go lower down where no permanent injury can be done, and the good effects will be the same. The reason why rupture of the drum head may be caused by these various things is that the air in the external meatus is suddenly compressed and strikes the drum head with great force, and this part either being unprepared does not yield to the pressure (for we all know how when expecting to hear a loud sound our ears are somehow felt to make ready for it), or owing to some obstruction to the Eustachian tube, the air cannot be driven out of it into the mouth with equal force to that with which the outside air strikes the drum. The artilleryman accordingly opens his mouth a little when his gun is fired, and so permits of the pressure being equalised on both sides of the tympanic membrane. The rupture, if simple, will probably give rise to little or no future evil result, as the wound heals readily, but if the sense of hearing be injured by the concussion, which it sometimes is, deafness and noises in the ear often result and remain during the life of the individual.

In connection with this I may mention that in some noisy trades, as boiler-makers, rivetters, &c., deafness is apt to come on, but here probably more often due to a form of chronic inflammation set up in the inner ear than from immediate injury to the drum.

A not unfrequent cause of injury to this membrane is picking the ear with a pin, knitting-needle, or something of the kind. When such an accident happens the best thing to do is to leave it alone, put no drops into the ear, for they will probably go further than wanted, only a bit of cotton wool into the opening of the meatus to prevent things from the outside getting in, when the wound will usually heal, and that is the best result to be desired. Of course if the injury has been done with force as from the jog of an elbow when one is picking the ear, or from a thorn when going through a hedge when hunting, or lying down upon a straw, and such penetrate deeper into the inner ear, irreparable damage is probably done at once.

Middle Ear.—We now come to perhaps the most important of the diseases of the ear, inasmuch as they are very frequent, arise from several causes, are often very chronic, and not unfrequently very dangerous, even causing the death of the sufferer. I shall only mention a few of the more important, and first, the so-called *running ears.* In this affection you have a more or less constant discharge from the ear of a mattery-like fluid, often with a horrible smell, frequently causing no pain, and consequently in too many cases not considered of much importance except it be the dulness of hearing which may be present. The disease is situated deep in the ear behind the drum, or more correctly perhaps where the drum once was, as it is now gone either in whole or in part, and often the small bones with it. When you are told further that the space is but small in size, and not far distant from the brain, you can readily imagine how the inflammation—for it is inflammation that we have to deal with, though not perhaps acute or sharp—can and does spread to that most vital organ in some cases, and causes the most dire results. One of the most common causes of this condition is scarlet fever, and it is one of the so-called dregs of this disease, as also of measles. It usually begins during the course of the fever, and is more apt to occur in

the person of a delicate child than in one who is strong, in fact, among such as Johnny, who you will remember Professor Maclagan described so vividly as being brought up in rooms, particularly his sleeping apartment, with too limited cubic air space, but all the same it is by no means confined to those. Whenever any of your children may be suffering from this fever, note carefully if he or she complains of pain in the ear or head, and draw the doctor's attention to it, or possibly the first sign you have of anything being wrong with the ear is that you notice a little discharge on the pillow, which at once have attended to, or the chances are your child may be deaf for life on one or both sides, or may even die in a fit from the irritation caused by the pain.

Another result of this inflamed condition of the middle ear is the growth of fleshy-looking lumps, or *polypi*, as they are called, sometimes small, at other times so large as to project from the orifice of the external meatus. For these you must consult a doctor, as they require to be removed. By attending to the above cause of them, you may often save yourself or your child, for they occur at all ages, from the pain of an operation, which, however slight to the surgeon, no one likes to undergo. Another result of this same inflammation may be paralysis of the face. Above all, never be convinced by any one that you or your child will grow out of this state of running ears, nor that the so-called drying up of them is bad. In the treatment of these things, the chief point is cleanliness. The ears should be gently syringed out two or three times a day with tepid water, putting a little Condy fluid or a pinch of soda into it; the former is advisable when the smell is bad, the latter when the discharge is thin and curdy-looking, as it helps to loosen and dissolve the masses of matter, which, if they remain in the ear, become very fetid and cause an increase of the irritation and mischief. Drops of various kinds may or may not be of use after the washing, but before venturing to use such ask advice, or you may do more harm than good.

When the tympanic membrane is partially or even wholly gone, the use of an artificial one in the form of a specially-made imitation drum head, or of a little bit of cotton wadding pressed down to where it was, may improve the hearing.

The most common cause of deafness, and it may occur to all and at any age, *is due to the result of a cold,* perhaps neglected as not being of much consequence at the time. The cold, or catarrh as it is called, has attacked the throat and nose, causing a dryness, followed by an excess of moisture about the parts; when in the nose it is the popular cold in the head or running at the nose. Should this continue, the mucous membrane, *i.e.*, the pinkish lining of the nose, mouth, &c., becomes thicker than natural, and the same condition spreading up the Eustachian tube, results in its becoming more or less closed, simply from the swelling, and in consequence air cannot pass freely up it from the mouth to the middle ear. You will remember what now occurs; the air in the cavity disappears or is absorbed, and the drum falls inwards, from the pressure upon its outer surface being greater than that upon its inner, and this being continued to the stapes or stirrup bone through the other two, it presses harder than it should upon the oval aperture, and through that on the fluid in the labyrinth, which, by interfering with the nerve of hearing, causes deafness, noises in the head, giddiness, &c.

Fortunately this form of deafness, when simple and not of long standing, is easily curable; and it is a pleasure and satisfaction to see the face of one who, a moment before, was deaf, after the slight manipulation of filling the middle ear with air again, hears perfectly. You can often do it for yourself, by holding the nostrils, shutting the mouth, and blowing, when the air is forced up the tube, and at once you perceive a flap or noise in your ear, due to the drum head going back into its proper place, and as long as the air remains in the ear cavity, so long does the hearing. This, however, may not suffice if the affection be of some standing, when the aurist has to be consulted, who, by means of a small tube passed up the nostril and into the mouth of the Eustachian tube, is able to blow air into the tympanic cavity. Do not, therefore, neglect a cold in the head or throat, thinking it does not much matter, as it, among other evil results, may be a cause of deafness.

Nervous deafness.—True nervous deafness, due to disease of the inner ear, labyrinth, or nerve of hearing, is fortunately not at

all a common disease, because it is quite incurable ; but some of the symptoms, the presence of which might indicate that these parts are affected, are common enough, and due to other causes, as dizziness, staggering walk, and deafness. The giddiness may be owing to a bilious condition, or to the pressure upon the drum of wax; deafness to any of the various things we have considered, and all may be caused by the taking of quinine. When a person is absolutely deaf to all sounds, even when directly conducted into the ear—as by a tube, or through the bones of the head, as when a tuning fork is sounded upon them—then we must regard the incurable condition as present. Among the causes of this nervous deafness may be mentioned injury to the ear, as from a severe blow on the side of the head, the concussion caused by the close vicinity of very loud sounds, spread of inflammation from the middle ear through the windows or foramina, and it may also be a result of severe fevers of various kinds, and of inflammation of the membranes of the brain. As to treatment, nothing, I am afraid, will avail as a cure in true nervous deafness.

Deaf mutism may be, generally speaking, due to a born or congenital condition of deafness, not, however, very common, for how few infants do we come across who are not easily awakened by noise; or it may be the result of disease occurring during infancy or childhood. In the first case, parts of the organ of hearing are awanting, as the labyrinth, cochlea, or semicircular canals; in the latter these parts are so altered by disease as to be useless, as occurs sometimes after scarlet fever, or long closure of the Eustachian tubes.

How do you discover whether your child be quite deaf or not? In the first place, a mother generally has her suspicions when her infant does not respond to her caresses, and especially does not look towards her when she speaks to it; but all the same she hopes against hope that in time, when a little older, it will act as others. When this does not come about she takes her child to a doctor for his opinion, and the test is simple enough, viz., to make a loud noise, as ringing a bell, close to the infant, but not permitting it to see you, and if no notice be taken, *e.g.*, not turning its head toward the sound, you can only say, deaf. At

the same time, when a door slams the child may take notice of it, not because it hears, but because it is very sensitive to vibrations, which are conducted to it through the floor.

The great point now is how best to educate such a child, and this is done in two ways:—one, by teaching it to converse by means of its fingers, as you have all seen; but this is limited in its use, because they can only converse with those in this way who can do so likewise.

In Germany, Sweden, America, &c., another plan has existed for a good long time, and is now well known in this country, viz., labial or lip speech, in which the child is gradually taught to look at the lips of one who is speaking aloud, and note the various positions the lips and tongue take when speech is made, and getting them to imitate, which a child of average intelligence will soon do. After a little while, by showing pictures, models, &c., the child is trained to speak though hearing not, and can carry on a conversation with another by looking simply at his mouth, and that so well that one author states from his observations that in a certain proportion of such one can hardly discover the speaker to be deaf, and that a considerable proportion of the remainder manage well enough for carrying on the ordinary work of life. The pronunciation of these is certainly somewhat peculiar, but that is nothing if one can make them useful to themselves and others.

In conclusion, I would just show you a few of the more usual ear trumpets, or instruments for assisting those who are partially deaf to hear. They all owe their power to their shape and to the material of which they are made (metal), for, like the speaking-trumpet used by mariners, they collect sounds by means of their wide mouths, and reflect them from side to side as they pass down to the small end, which is placed in the ear. These are increased by their cavities being resonant, which always intensifies sounds. Some of these are for hearing a speaker at a distance, others when close at hand, in fact, speaking directly into the tube. Their shapes are various, and each should suit himself to that form which affords most assistance.

THE EYE: THE ORGAN OF VISION.

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The subject to which I desire to direct your attention this evening is so wide in its scope that I shall only be able very briefly to allude to some points upon which I might with advantage dwell more fully, and to omit entirely the consideration of many of considerable importance and of no little interest, but for the discussion of which the time allotted to such a lecture as this would prove much too short. All that I can hope to do is to give you a very general idea of the structure of the eye, to point out its exquisite adaptation to the function of vision, and to give a few hints as to the best means of preserving the sight.

I must at the outset claim your kind indulgence should I fail to make the whole subject perfectly clear and intelligible to you all, as some of the points to which I may have occasion to refer are perhaps rather more intricate than is common in a popular lecture, but without allusion to which justice could not be done to the beautiful structure of the eye.

It is by the aid of our senses that we are in communication with the external world. By them we are made aware of the qualities and conditions—nay, the very existence of the various objects by which we are surrounded, and which impart pleasure to our life. Our senses constantly gather from all quarters information, which they by special nervous channels convey, or telegraph as it were, to our brains, there to be read by the mind and used as it may direct.

These senses are five in number—sight, hearing, touch, taste, and smell, and each resides in an organ or set of organs wondrously adapted to its requirements. Without them we should have no knowledge of our own physical nature, or of the objects beautiful and varied by which we are surrounded; we should be unable to communicate with our fellow-men; we should be bereft of all intellectual power; but I should fail to describe what we may vainly attempt to conceive—the utter blankness of our condition, if we possessed not these faculties. It is to them we are indebted not only for a knowledge of what falls under our own direct observation, but for that vast sum of human information which their exercise during 5000 years has slowly accumulated.

But of all these senses I claim for sight the foremost place, and that on many grounds of which I may indicate but a few. It stands pre-eminent, 1st, in respect of the *extent* of the field with which it brings us into relation. Let an object lie anywhere between a few inches from our eye and a distance utterly beyond our conception, and we can by an effort, of which we are scarcely conscious, bring ourselves into relation with it. Let it be so vast that our minds cannot realise it, our eye will nevertheless take it all in and figure it with the greatest precision. Let it be so minute as to be beyond the ken of our other senses, the eye will still mirror it to perfection. If we call instruments to our aid, we can examine the general form and arrangement of objects the most distant, and the most minute structure of those within our reach.

It stands pre-eminent, 2dly, because of the *variety* of information which it directly conveys, for it tells us at once of form, distance, size, colour, number, and texture.

It stand pre-eminent, 3dly, on account of the *rapidity* with which information is brought to the eye and appreciated by the mind, the process being almost instantaneous.

It stands pre-eminent, 4thly, by the *very wonderful structure* of the organ in which it resides—a structure which it is one of the chief objects of this lecture to explain to you.

Besides such direct evidences as these I may for a moment

advert to some implied proofs which we find in common language, in Holy Writ, and elsewhere. I believe in all languages the expression "to see" is employed as synonymous with "to understand or comprehend," which is not the case with any of the other senses. Thus we express the noblest function of the human mind by the use of the figure "seeing," while feeling and taste, and even hearing, are applied to lower attributes. And I think we may be warranted in saying that a greater nobility belongs to sight than to the other senses when we observe how God in ancient times revealed Himself always through other organs, while it is expressly declared that no man shall *see* Him and live. In his great creative work, too, one epoch was marked by the formation of that matter, or rather quality of matter, which is appreciated by the eye alone, when God said, "Let there be light." I do not desire to depreciate the value of the other faculties we possess while I vindicate the superiority of sight, but I am anxious you should have a just appreciation of the wonderful gift God in His goodness has granted in the sense of sight.

The late Dr Thomas Reid, the eminent professor of Moral Philosophy, thus expressed his opinion on this point. "Of the faculties called the five senses, sight is without doubt the noblest. The rays of light which minister to this sense, and of which without it we could never have had the least conception, are the most wonderful and astonishing part of the inanimate creation." "If," he further remarks, "we should suppose an order of beings endued with every human faculty but that of sight, how incredible would it appear to such beings, accustomed only to the slow informations of touch, that by the addition of an organ consisting of a ball and socket of an inch diameter they might be enabled in an instant of time, without changing their place, to perceive the disposition of a whole army, or the order of a battle, the figure of a magnificent palace, or all the variety of a landscape? If a man were by feeling to find out the figure of the Peak of Teneriffe, or even of St Peter's Church at Rome, it would be the work of a life-time. It would appear still more incredible to such beings if they were

informed of the discoveries which may be made by this little organ in things far beyond the reach of any other sense; that by means of it we can find our way in the pathless ocean, that we can traverse the globe of the earth, determine its figure and dimensions, and delineate every region of it; yea, that we can measure the planetary orbs, and make discoveries in the sphere of the fixed stars. Would it not appear still more astonishing to such beings if they should be further informed that by means of this same organ we can perceive the tempers and dispositions, the passions and affections of our fellow-creatures, even when they want most to conceal them? That when the tongue is taught most artfully to lie and dissemble, the hypocrisy should appear in the countenance to a discerning eye? and that by this organ we can often perceive what is straight and what is crooked in the mind as well as in the body? How many mysterious things must a blind man believe if he will give credit to the relations of those that see? Surely he needs as strong a faith as is required of a good Christian."

The eye is further one of the most expressive features of the human countenance. I am aware that this is a view that does not meet with universal acceptation. Thus the late much respected Principal of the Edinburgh University, Sir David Brewster (whose views most justly carry great weight with men of science), in one of his inaugural addresses to the students at the Edinburgh University, in referring to some, perhaps extravagant, laudations of the power of expression in the human face enunciated by Prof. Carus, remarked, "There is no expression in the human eye, consisting of a transparent cornea, a coloured iris with the pupil in its centre, and the white sclerotic coat. You may as hopefully search for expression in a watch-glass as in the cornea, as hopefully in a coloured wafer with a hole in the centre as in the iris, and as well in a piece of white kid leather as in the sclerotic coat."

In pleading against this opinion, I would appeal to the universal experience of man; for who is there that is not accustomed to judge of the characters of strangers whom he may meet, or the

state of the mind of friends by the expression of the eye? and do we not find in common acceptation the terms noble, fierce, greedy, cunning, haughty, modest, intellectual, &c., applied to the eye? and does not the Poet Laureate speak of a sensitive man being "gorgonised with a stony British stare?"

Is it possible that so many common expressions should exist if the eye were a dull meaningless ball? or that it should be so universally accepted as an index of the inner man if it were not really what I claim for it—one of the most expressive features of the body?

I acknowledge it may be argued that, admitting the expression to exist, it resides more in the eyelids and other appendages than in the eye itself, and there is a considerable amount of force and truth in this assumption; but where, let me ask, is the expression of an eye disorganised by disease, or who ever heard of the language of a glass eye? It is told of a gentleman whose public position led to his being frequently examined as a witness before Parliamentary Committees, and who having had the misfortune in early life to lose one of his eyes had replaced it by a glass one, that in his examination in chief, when expounding his own views, he turned the full light of his rich expressive eye upon the members of the Committee, but when cross-examination began he fixed upon them the dead dull stare of his glassy organ, with the effect, it is said, of greatly discomposing his adversaries.

Having said thus much regarding the importance of our subject, I shall now endeavour to explain to you the structure and functions of the eye. But let me first for a moment direct your attention to the position of the eye. We observe that it is placed in the upper part of the body, by which arrangement we are enabled to see above numerous small objects, which, if the eye were situated on a lower plane, would limit the extent of vision. We may also observe that the eye is placed in a bony socket, which serves in a most efficient manner to preserve it from most forms of external injury, the eyebrows, nose, and cheek standing forward to ward off any blow. Let me suppose for the sake of illustration that the eye were situated in the leg, how continually would it be exposed

to the danger of blows from small objects, which in its natural elevated position it is free from, and how contracted would be our range of sight; every paltry bush, every good-sized stone would intercept the line of vision, and thus our sight would generally be limited to a small circumscribed spot in our immediate vicinity. Thus we see even in the position chosen for the reception of this important organ an illustration of the wisdom of the Creator.

Let us now consider the structure of the eyeball.

The eye is a hollow globe or sphere within which are contained various structures entering into the mechanism of vision. This globe or sphere is composed of three coats or coverings, each of which differs in structure from the other and serves a different purpose.

The outermost of these coats is thick, tough, and elastic, and is in particular the protective covering of the eye. It is it, moreover, which imparts to the white portion of the eye its beautiful colour. This coat is termed the sclerotic. Within this coat we find what may be viewed as the nutritive coat, as it is richly supplied with blood-vessels, by which the waste occurring in the various tissues of the eye is mainly supplied. But besides blood-vessels, this coat contains a thick layer of a black substance, to which we apply the term black pigment, the use of which is to absorb those rays of light which pass through the innermost coat, and which if not absorbed would render vision confused and indistinct.

The innermost of the three coats of the eye, and which we may call the sensitive coat, ranks certainly as the most important of the three, for while the other two may be said to be merely accessory to vision, this is the one through which the impressions of external objects are conveyed to the brain. This coat is termed the retina. It is in part composed of an expansion of the optic nerve, or nerve of sight, to which, however, there is superadded certain delicate structures sensitive to the impressions of light, the fine extremities of the nerve of sight serving mainly the function of conveying a sense of these impressions to the brain, our great percipient organ.

The arrangement of these coats deserves a passing word of notice. The firm protective coat is placed externally to ward off injuries, the nutritive coat is conveniently placed centrally, while the delicate, finely-organised structure needed for the sensitive coat occupies the innermost place, furthest removed from injurious influences.

These are the coats of the eye, but it is evident that if these coats were completely continuous, the rays of light could not obtain access to the sensitive innermost coat of the eye, which is essential for vision; and here we observe a beautiful provision of nature in an alteration in the structure of the protective coat at the front part of the eye, its thick dense opaque structure being replaced by an exquisitely clear transparent substance, possessing, however, great firmness, termed the cornea. The choroid and retina, too, do not extend so far forwards. The cornea may be viewed as the window of the eye, and serves the two purposes —of permitting the passage of the rays of light into the interior of the eye, while at the same time it serves as a continuation of the protective coat.

Let us now glance at the structures contained within these coats. Within the window of the eye we perceive a structure which may be viewed as the curtain of the eye. It is a thin membrane of circular form, having in its centre an aperture—the pupil. From the variety in colour which this membrane presents in different individuals (blue, grey, brown, or black) it has received the designation of the iris or rainbow. It is by it that the amount of light admitted to the interior of the eye is regulated; and just as we draw the curtains when the sun is shining into a room with painful brightness, or withdraw them as the evening advances, so does this beautiful curtain, independent of any effort on our own part, contract or expand according to the intensity or feebleness of the light. The power of dilating and contracting the pupil resides in two sets of muscular fibres (or contractile bands or strings), one set being arranged circularly round the pupil, the other passing in a radiating manner (like the spokes of a wheel) outwards from the

pupil. The first set act like the string round the mouth of a bag, and when they contract draw the iris towards the centre, thus lessening the size of the pupil. The other set, on the contrary, when they act serve to draw the iris from the centre, and thus increase the size of the pupil.

It is extremely interesting to watch how exquisitely this arrangement acts, which is readily done by placing the subject of experiment in front of a window or otherwise in a good light, and shading his eyes by covering them with the hand for a few seconds. The pupil while the eye is thus shaded becomes much enlarged, but the moment the covering is removed contracts with great rapidity.

Situated behind the iris is the crystalline lens, a beautiful clear magnifying glass suspended immediately behind the pupil. The round white ball which many of you I daresay have noticed in the eyes of boiled fish is this structure, the crystalline lens rendered opaque by the process of cooking. In health it is, as I have said, transparent as the finest crystal, but in some people as age advances it becomes hazy, and eventually opaque, constituting the condition termed cataract. Between the lens and the cornea we have a fluid termed the aqueous or watery humour, which differs little in composition from pure water. The space behind the lens is occupied by what receives the appellation of the vitreous (or glassy) humour. In appearance and consistency it very much resembles a thin, clear, colourless jelly.

I have now, I hope, given you a general idea of the structure of the eyeball, and shall next direct your attention shortly to the mechanism by which the eye is moved.

As it is necessary for perfect vision to direct the eyes towards any object we desire to see, we find in nature two modes whereby this is effected with the least degree of inconvenience. We observe abundant illustrations of the one method in insects, some of which possess a great multiplicity of eyes. Thus we find the spider provided with eight eyes arranged in a circle round its head, and so placed as to enable it to look in all directions. In

the working bee there are above 3000 eyes, in the beetle above 6000, and in the common house-fly 8000, which are arranged in two large groups placed on either side of the head. In these animals the eyes are fixed, and hence the necessity for the number they possess, by which means they are enabled without moving to see on every side of them. In man and the higher animals, however, we find the number of eyes reduced to two, but to compensate for the want of number they are endowed with motion, whereby we are able at will to fix our eyes on any object. This result is effected by means of what are termed muscles or bands of fibres, which (like those we described in the iris) under the influence of nervous force contract. The muscles by which the eye is moved are six in number—one serving to raise or elevate the eye, one to depress it, one to turn it to the right, one to turn it to the left, while the two remaining muscles roll or rotate the eye, as it were, on a central pivot. The first four muscles are all attached to the back of the *orbit*, or bony cavity in which the eye is lodged, and passing forwards over the eyeball are attached to it close to the edge of the cornea. It is evident that by their alternate contraction the eye will be elevated and depressed, and turned to one side or the other, and that by the simultaneous action of two neighbouring muscles the eye may be turned in any intermediate direction. The use of the other two muscles that roll the eye was at one time the source of much diversity of opinion, but it appears now to be universally accepted that these muscles enable us to see objects upright, even when the head is held in a slanting direction.

There are still some structures which, though not constituting parts of the eyeball, yet are of essential consequence to its preservation, and thus require mention at our hands.

It must be manifest to all that were so delicate an organ as the eye exposed to the contact of dust and other irritating substances, which are always to a greater or less extent suspended in the air, mischief to the eye would infallibly soon result—the transparency of its clear structures, which is essential for sharpness of vision, would be interfered with, and, like the view we obtain of objects

through a very dirty window, we would be almost as much embarrassed as aided by the distorted and indistinct image we would thus obtain. To cover and protect the front of the eye and to close it from the access of light during sleep we are provided with eyelids, which may be viewed as the shutters which cover the window of the eye. The eyelids not only protect the eye from dust and other causes of irritation, but also serve an important purpose in directing the flow of tears over the surface of the eyeball, which moistening of the eyeball is not only essential for the preservation of the transparency of the clear texture of the eyeball, but also permits the lids to glide with the most perfect smoothness and freedom from friction over the surface of the eye. The edges of the lids are fringed with eyelashes, which ornament the eye, but also serve to prevent small insects or larger particles of dust from coming in contact with it.

The tears which I have alluded to as essential for the lubrication of the lids and for the preservation of transparency in the clear tissues of the eye are secreted (that is to say, extracted from the blood) by a structure termed the lachrymal gland, a body consisting of a number of very minute vesicles or bags, which have the power of extracting from the blood circulating in their walls a watery fluid—the tears—which is collected in the interior of the bags, and from them conducted by ducts or tubes on to the surface of the eyeball. This gland is situated above and to the outer side of the eyeball, and the tears partly gravitate and are partly directed by the lids to the part of the eye next the nose, where they are again taken up by two small ducts, which convey them into a larger tube, by which they are conducted to the nose.

To prevent the tears passing over the lids, we perceive a beautiful contrivance in the presence of a row of small glands on the inner surface of the lids, by which a greasy substance is secreted, which, greasing the edge of the lids, arrests the flow of the tears. In the healthy eye, it is only when it is exposed to some irritating cause, or when the mind has been affected by some strong emotion, that the greasy line fails to prevent the passage of the tears over the edge of the lid on to the cheek.

Having thus shortly described the more important of the textures that are concerned in the function of vision, let me now briefly advert to the adaptation of all these structures to the sense of sight.

In every organized being we observe a distinct susceptibility to the influence of light. We see the sunflower revolve its head towards the sun, the daisy and unnumbered other flowers open their blossoms in the morning to the light, and close them as the shades of evening fall. We see animals of the lowest type increase in activity as the light of the sun falls on them, and the sea anemones at the bottom of the rocky pools open up under its influence. But as we pass up in the scale, a higher organization demands, in addition, special organs for receiving its impressions.

In many little more is required than an organ capable of distinguishing light from darkness, and accordingly the simplest structure suffices for their wants. The worm, for example, which in its earthy habitation would find good eyes rather an encumbrance, is provided with a few little knobs of sensitive, nervous matter which amply serve its purpose, while the higher creatures require and therefore possess a more perfect mechanism. In the highest animals we find the eye developed into a very perfect optical instrument.

But to explain its mechanism, it is necessary that I should make a few explanatory remarks respecting the nature and direction of the rays of light by which we see. Some may here remark that light is not essential for vision, inasmuch as some animals see in the dark. This, however, is a statement founded on error, a popular fallacy, as *no* animals can see in the dark. Some, especially animals who seek their prey by night, are possessed of very sensitive eyes, and see remarkably well when the light is very dim, and like the owl or bat, dazzled by the bright light of day, seek during sunlight some dusky habitation. But where light is absolutely excluded, there sight too is abolished.

Rays of light then may, for one purpose, be divided into two classes—*first*, those proceeding from a source of light, as those

from the sun or moon, or from the flame of a lamp or other artificial source of light; and *second,* those rays which are reflected from the surface of material objects. It is by the passage of this latter class of rays to the retina that we obtain an impression of the object from which they were reflected. But it is not merely necessary that these rays should strike the sensitive coat of the eye, but also that they there should form a distinct image of the object from which they proceed. To obtain this distinct image, the rays of light which, as they proceed from the object, are divergent (or spread out), must be so altered in direction as to come to a focus, as it is termed (that is to say, to meet at a point), on the surface of the retina. To bring this about, some of the structures I have already described are brought into use. The divergent rays of light, in passing through the cornea, are by it sensibly changed in direction, which alteration in their course is much increased by their passage through the lens, the result being that they become gradually approximated, till eventually they meet at the retina, and then form an exact though inverted image of the object from which they proceeded.

We find, however, that rays are not always equally divergent, but that the nearer the object is to the eye the more divergent are the rays that pass into the eye, and that, consequently, to bring rays of different degrees of divergence to a focus at the same point—viz., the surface of the retina, we require a means of altering the power of the lens according to the distance at which the object is which we desire to see. This is accomplished by a muscle of a circular form, situated opposite the margin of the lens, which, by its greater or less contraction, increases or diminishes the power of the lens. This power of adapting the eye to different distances is termed the power of accommodation or focussing, and the muscle that affects the alteration is called the muscle of accommodation.

To render this somewhat intricate subject a little more clear, allow me to compare the eye to an instrument framed in imitation of it—the photographic camera. The wooden frame of the instrument blackened on the inside represents the outer

and middle coats of the eye, the brass tube with lens in front are counterparts of the cornea and crystalline lens, while the ground glass plate at the back of the instrument represents the retina. If we watch the photographer's movements, we may observe him, after carefully directing the front of the camera to the object to be photographed, stretch his hand forwards towards the brass tube, and by a few turns of a screw, satisfy himself that he has on the plate of ground glass the most sharply defined image of the object he can obtain. The screw in this instance corresponds to the muscle surrounding the lens in the eye, and according to the distance of the object to be pictured, so has the photographer to give the screw a few turns backwards or forwards. And as we often see blurred or defective photographs, which, upon enquiry, we learn are due to the object being "out of focus," so should we, were we deprived of the power I have described, obtain but dim, ill-defined images of surrounding objects.

It is interesting to notice the changes that occur in the shape and texture of the lens with advancing years. In infancy the lens is very much curved and of soft consistence, but as age advances it becomes more and more flattened, and much more dense and unyielding in structure. Thus it happens that it is much less easily acted on by the muscle of accommodation, the result being, that while the eye is capable of producing sharp and well-defined images of distant objects, near objects cannot be distinctly perceived. This is the condition of aged sight, which necessitates the employment of spectacles with suitable magnifying lenses, for reading, writing, sewing, &c.

But the eye appreciates not merely the form of an object, but also that infinite variety of colour with which the Almighty has enriched and beautified the works of His creation.

It has been frequently debated whether this, the perception of colour, is in all respects a natural gift, or whether it may not, in part, at any rate, be the result of education; and our undoubtedly able and versatile Premier, Mr Gladstone, has favoured the latter view, mainly from the circumstance that Homer, the Greek poet,

has in his works spoken of the colour of objects in a very indefinite and inaccurate manner. Thus in his Juventus Mundi (page 539), Mr Gladstone says:—"To us of the present day, colour and its broader distinctions are familiar from childhood upwards. But in the first place, it is to be borne in mind that the acquired knowledge of one generation becomes in time the inherited aptitude of another. In the second place, much of our varied experience in colour is due to chemistry and to commerce, which brings to us the productions of all the regions of the world. Mere nature at any one spot does not present to us a full and well-marked series of the principal colours, such as to be habitually before the mind's eye. Thirdly, the curious investigations of late years have shown us that, even now and in our own country, no inconsiderable proportion of persons are without the faculty of perceiving some of the primary distinctions of colour."

I cannot but think that Mr Gladstone does not show much judgment in taking a poet's descriptions as evidence of the power of perceiving colour that prevailed among educated people at his time. Poets have had very considerable licence allowed them in the employment of figurative language at all periods of the world's history, and the exactness of their language in the description of material objects is not to be trusted. And even although one might conclude that Homer did not perceive colours correctly, it were certainly a rash inference to arrive at that a similar failing prevailed among all educated people of his time. The circumstance that colours are correctly employed in Old Testament Scripture, and that among barbarous tribes at the present day a clear and accurate perception of colour exists, sufficiently I think proves the fallacy of the doctrine that for recognition of colour education of the sense is necessary.

Mr Gladstone alludes to the prevalence of colour-blindness, and as this is a subject of much interest, and one engaging much attention at the present day, I may be permitted shortly to refer to it.

Colour-blindness (or Daltonism, as it is frequently termed, from the circumstance that Dalton, the chemist, was affected with it,

and described his condition accurately) may be the result of injury or disease of the eyes, but is in the vast majority of cases a congenital defect in which, while the eyes may be capable of most accurately distinguishing the form and light and shade of an object, they are incapable of recognising the existence of certain colours.

The most common variety is that in which there is an inability to perceive red, and this is called red-blindness; the next most common is that in which green can not be perceived—this is termed green-blindness; while a rare variety is that in which violet cannot be distinguished.

There are only four or five cases on record in which persons were incapable of distinguishing any colour, and none of them have been very thoroughly investigated, and their condition fully described. The one of which we have the best account it described in Dr Wilson's book on colour-blindness, who, however, has only his information second-hand. The person affected with this peculiarity of vision was, strange to say, a house-painter, and declared he could not distinguish any colours but black and white. The explanation of his prosecuting a calling for which apparently he was so unfitted, is found in the fact that he was an excellent draughtsman, with a good eye for form, and skilful in designing. He trusted to his wife to keep him right in selecting and mixing colours; but on one occasion when she was out of the way, and workmen were scarce, he personally took a part in painting a public building in England, which he had been employed to put in order. He mixed the colours himself, and believed that he had produced a *stone* tint, with which he proceeded to cover the walls; but after he had gone over some square yards, he was informed that he was painting the building *blue*.

Persons who are colour-blind may remain in ignorance of their defect for many years, until some startling circumstance occurs which reveals their condition to themselves and others. Numerous examples of this are on record, of which I may relate a few.

Thus a friend of my own affected with colour-blindness informed me that on one occasion, when visiting a friend in the

country who was proud of his well-cultivated garden, he was shown a bed of geraniums in front of the house, to which his friend pointed with an air of satisfaction, exclaiming, "Isn't that a magnificent display!" "Yes," responded the visitor, "they do seem a remarkably healthy set of plants." This appearing to the self-satisfied proprietor a somewhat inadequate response, he said, "But is not the blossom splendid?" "Blossom!" said my friend; "I see none;" and it was only on approaching close to the flowers that he distinguished by the form that the bed of geraniums was one mass of scarlet bloom.

An artist is recorded to have had a pupil apprentice, whom he released from his engagement in consequence of finding him copy a brown horse in bluish-green, paint the sky rose-colour, and roses blue.

A carver and gilder, who was a good draughtsman, painted a head with the face muddy-green, and mistook a packet of emerald green for vermilion.

Several members of one family, belonging to the Society of Friends, were markedly colour-blind. One of them provided himself with a bottle-green coat, intending to purchase a brown one; and selected for his wife, who desired a dark gown, a scarlet merino. Another, who was an upholsterer, purchased scarlet for drab, and had to rely upon his wife and daughters to select for him the fabrics needed in the course of his trade. A third, who was a farmer, could not tell red apples from the surrounding green leaves, except by their shape.

The case of a minister, in the Society of Friends too, is recorded, who selected scarlet cloth as the material for a new coat.

A doctor affected with colour-blindness states that in purchases he made many mistakes. He bought a red dress, thinking it a green one. He has bought red and green trousers, thinking they were brown, and had to get them dyed afterwards to enable him to wear them. In Paris he bought a red cap to wear instead of a hat, thinking it a green one.

A tailor's foreman only became aware of his defect on promotion when he had to match colours for the journeymen. He

was soon involved in grievous difficulties. The *scarlet* back of a livery waistcoat was provided with *green* strings *to match.* A ruddy brown was put side by side with a dark green, while a purchaser was informed that a red and blue stripe on a piece of trouser-cloth was all blue.

An amusing account is given of the presentation of Dalton at court. "Firstly, he was a Quaker and would not wear the sword, an indispensable appendage of ordinary court-dress. Secondly, the robe of a doctor of civil laws was known to be objectionable to him on account of its colour, scarlet—one forbidden to Quakers. Luckily it was recollected that Dalton was afflicted with colour-blindness, and that as the cherries and the leaves of a cherry tree were to him of the same colour, the scarlet gown would present to him no extraordinary appearance. So perfect, indeed was the colour-blindness, that this most modest and simple of men, after having received the Doctor's gown at Oxford, actually wore it for several days in happy unconsciousness of the effect he produced on the street."

Dr Wilson states that he knew of cases among haberdashers and silk mercers, and on enquiring at one of the latter, who had served under a colour blind master, and thereby had his attention directed to the matter, what became of those haberdashers who could not distinguish colours, obtained the unexpected reply "that they generally ended in mourning warehouses."

Numerous investigations have been made into the prevalence of this defect by observers in different parts of the world, and their results on the whole closely correspond. An examination of above 50,000 males showed that about 4 per cent. or one in twenty-five of the whole male population are colour-blind, while, marvellous to relate, colour-blindness is much more rare in females, only about one in 500 or 600 being thus afflicted. The large extent to which this defect exists among males, and the circumstance that the colours which are not recognised correspond to those employed in signalling, shows the necessity that exists for a careful examination as to their colour sense of engine-drivers, stokers,

signalmen, in fact all men who are employed upon railways; as also of pilots and officers, and crews of steamers and sailing vessels at sea. One can readily understand how a mistake in recognising the colour of the signal lamp may, on a railway, lead to a most disastrous collision, with great loss of life and injury. At sea a green light is displayed on the starboard side, and a red light on the port side, to indicate the position and direction of a vessel in motion, but if the seaman on the look-out or the man at the helm is colour-blind and fails to distinguish the one light from the other, that which is intended as a guide is of no value to him, and the ship may thus be placed in imminent danger. Scientific men having had their attention directed to this subject, carefully tested whether moving signals or signals of varied form might not replace signals of varied colour, or whether multiple white signals might not be employed. But they arrived at the conclusion that the coloured signals were on the whole the most convenient and satisfactory for use. There can be no question, however, that in the interest of public safety, all seamen and all men employed on railways should, prior to engagement, undergo a careful examination as to their perception of colours. This is done only in a rough way by railway companies in this country, but much more efficiently in Norway, Sweden, Holland, and many parts of the Continent; while no examination, as far as I am aware, is made regarding this perception of colour in the Royal or Merchant Navy.

A great many methods of testing a person's power of perceiving colours have been recommended, but the simplest and most efficient is to place a number of small skeins of Berlin wool of different colours on a table-cloth or other light ground, and taking one, say of a light green colour, ask the person to be examined to place beside it all the other skeins of a similar colour. Should he do this readily without a mistake, he may next be tested in a similar manner with a purple skein, and if he stands this test he may be considered to have a correct perception of colour. The mistakes made by the colour-blind are often most

startling—yellow, grey, and green skeins being assorted together, or bright blue and deep gray and purple.

There are many points upon which I would like to speak, such as the great increase in delicacy of the other senses (especially hearing and touch) in those bereft of sight, the method of instruction of the blind, and the wonderful light that has been thrown upon the nature of diseased conditions in the interior of the eye by the invention of the ophthalmoscope, a small and simple instrument, whereby a beam of light can be thrown through the pupil into the interior of the eye, and the whole of the depths of that organ examined as clearly as its outer surface. But time fails me, and I will conclude by impressing upon you the duty of cultivating the valuable gift you possess in sight, and give some hints as to its preservation.

It is worthy of remark the extent to which vision may be improved by cultivation. And this is due, not only to an increased accuracy of observation, but to a greater acuteness acquired by the organ itself. The Indian who tracks among the winding paths of the American forests the particular footstep of his friend or foe, does so not merely by his accurate power of observation, but also by the delicate sensibility which practice has developed. The botanist who in his walks sees every plant that blooms beside his path, enjoys the reward of the cultivation his eye has received. The sailor who traces in extremest distance the faint white line of breakers that marks the hidden reef—a line invisible to the inexperienced who stand beside him—affords another illustration of what constant practice may do for the improvement of vision.

It is a duty which we owe to our Creator who has endowed us with this wondrous faculty, to cultivate it by every means within our power; and the performance of this duty is its own reward, for the more the eye is cultivated, the more varied and minute are the pictures it gives our minds of the scenes among which we live, and the greater is the pleasure we draw from the boundless field of nature.

But it is no less our duty to do all we can to preserve our

sight. Disease often comes on so insidiously, and becomes so serious before attention is directed to it, that art may fail to cure what a little care might have prevented. It is impossible for me here to lay down a code of laws which should regulate you in the employment of your eyes. All I can do is to point out a few circumstances which tend to throw an additional strain upon, or serve to irritate them, so that this may be avoided.

To work in a subdued light is by many supposed to be advantageous to the eyes. This, however, is erroneous; when the light has become so obscure that the occupation can only be pursued with difficulty, then the strain upon the eyes is quite as injurious as would be a dazzling glare of light. Here, as in many other things, extremes are to be avoided, and the bright diffuse light of day (out of the direct sunshine) is the best light for most occupations. Where, however, artificial light must be used, a steady light sufficient brightly to illuminate the work we have to do, without dazzling and without overheating the room, should be chosen. The light should be placed above and a little to one side. Almost all artificial light, whether proceeding from lamps, candles, or gas, differs from daylight in possessing a larger proportion of red and yellow rays, which is a source of irritation to many sensitive eyes. This may be obviated by slightly blue-tinted globes to the lamp or gas, or by wearing blue-tinted spectacles, whereby the light is softened and made more like daylight.

The attitude while at work is of great importance. The head should be as far as possible kept erect, and the work if necessary elevated on a suitable stand or desk, so that the necessity for stooping may be avoided. The stooping posture causes an increased flow of blood to the head and eyes, inducing a feeling of discomfort often to such a degree as to demand a desistance from work. Where there is any shortsightedness too, prolonged stooping is productive of an aggravation of that defect, and may even lead to serious mischief in the interior of the eye; and even where the eyes are healthy and not near-sighted, prolonged work

in the stooping posture may induce such over distension of the vessels in the interior of the eye, that their coats may give way, and great temporary and even considerable permanent impairment of vision result.

At the present time, when cheap literature is in demand, the type is often most trying. Examples of this we find very common in the daily newspapers. Those whose sight is somewhat defective should eschew the paragraphs or columns in small indistinct type, and should give deserved preference to those papers that are well printed on good paper.

Reading habitually while travelling by rail is another common source of hurt to eyes that are not strong; the constant movement imparted to the paper by the vibration of the carriage causes an increased strain upon the eyes.

The persistent application of the eyes to fine needlework which is so prevalent at the present day, is also frequently productive of mischief, especially in those who are shortsighted, and who pride themselves on the fineness of the work they can accomplish.

As I had occasion to explain at a previous part of this lecture, as age advances the power of accommodation (or focussing of the eye) fails, and the necessity arises for the use of spectacles for reading or seeing objects distinctly near at hand. Many put off as long as they possibly can the employment of these aids to vision, under the idea that spectacles serve to weaken the sight. This is a great fallacy, as the strain thrown upon the eyes by attempting to work without spectacles when spectacles are necessary, may be the source not only of pain and annoyance, but of positive disease, which may be readily averted by the use of suitable glasses.

Lastly, tobacco or stimulants used in excess may be the cause of serious impairment of vision. I am far from taking the extreme step of denying persons either of these luxuries, but I only desire to mention that when indulged in *to excess*, they are injurious to the eyes. A strong healthy man engaged in arduous physical occupation may in safety, and perhaps with advantage,

at any rate with comfort, smoke his pipe, and quaff his glass of beer, while a weakly, delicate man, whose work keeps him seated at a desk most of the day, may find even what appears a moderate amount of tobacco or stimulants produce a general derangement of the nervous system with failure of the sight. In this, as in all things, true temperance, that is to say moderate enjoyment, should be the rule.

Finally, I cannot omit in a lecture such as this, some reference, however slight, to the procedure to be adopted in some of the more common diseased conditions and accidents to which the eye is liable. I need scarcely say that in all cases skilled advice should at once be sought, and my remarks will be strictly confined to what should be done in urgent cases in the time that may elapse ere professional assistance can be obtained. In all severe inflammations of the eye, simple bathing with water (either cold or tepid as the sensations of the sufferer may direct) is the safest remedy to employ, and no lotion or other application, however strongly recommended, should be had recourse to, till sanctioned by medical advice. I cannot too strongly deprecate the practice very commonly followed of applying poultices of bread and water, bread and milk, tea-leaves, porridge, or other substance to an inflamed or injured eye. There are a few diseased conditions in which poulticing is productive of benefit, but in the great majority of inflammatory affections, poultices serve simply to aggravate the disease, and convert what was a simple and by no means serious affection into a severe one, endangering the sight. Keeping wet cloths applied to the eye, and bandaging up an inflamed eye, though, like the poulticing, apparently a very simple and harmless procedure, may also be productive of much mischief, and should never be employed without the orders of the surgeon. I have seen, and continually see, too many instances in which eyes have been seriously damaged by the use of poultices, by the application of wet cloths, and even by simple bandaging of the eye, not to seize this opportunity of sounding a warning note, which, I trust, may help in diminishing the number of such cases.

In like manner, lotions or eye-drops or eye-salves that are beneficial in certain inflammations of the eye, are most injurious in their influence upon others, and should never be used indiscriminately upon the recommendation of some well-meaning but most reprehensible friend, who may have found the application recommended of service when he himself happened to be afflicted with a sore eye. It must be borne in mind that inflammations of the eye are very multifarious, and remedies must be suited to each individual case, and that it is only one who has scientifically studied those affections who can discriminate the various types of inflammation, and thus prove a safe adviser as to the treatment to be adopted.

Very recently I saw a man who had been troubled for a considerable time with a slight inflammation and redness of the margins of the eyelids, and who, noticing that a sister affected with a chronic skin eruption had been very much benefited by a certain lotion, thought his eyelids might be improved by the same. He, however, soon discovered that his reasoning was in some way defective, as very severe inflammation of the eye resulted from his application, which inflammation was with difficulty cured.

Although the eyelids serve, as a rule, as efficient protectors to the eyes, it occasionally happens that some fine particle of dust or sand escapes their vigilance, and obtains admission to the eye. The irritation produced by its presence induces a copious flow of tears, whereby the offending body may be at once washed out; but sometimes the irritating substance finds its way under the upper eyelid, and remains fixed there by the pressure of the lid, causing great annoyance whenever the eyelid is moved. Means must at once be adopted for the removal of the foreign particle. In some cases simply plunging the face into cold water and opening the eyes under the water will suffice, but generally the eyelid requires to be everted (that is to say, turned inside out), and the offending body picked off, or what often answers admirably, the upper eyelid should be drawn forwards off the

eye by means of the eyelashes, and the lower eyelid pushed up under it. When the eyelids are released the eyelashes of the lower lid will brush over the inner surface of the upper lid, and almost certainly remove any substance that may lodge there. Should such simple means fail, the eye may be tied up with a pad of cotton wool over it, so as to prevent the eyelid moving till professional advice be secured.

Frequently serious damage is occasioned by lime or other caustic substance getting into the eye. When this accident happens the eye should as quickly as possible be thoroughly washed with cold water, a stream of water being allowed to course across the opened eye, while any particle of caustic substance that remains should be carefully removed. A drop of castor oil or olive oil applied every half-hour to the inside of the eye will help greatly to allay irritation. All bandaging or poulticing in such circumstances is most injurious.

Wounds and injuries of the eye, even those apparently of a trivial nature, may, in many instances, be productive of disastrous consequences. Professional advice should be obtained without delay, as often injuries slight in extent, and produced by such a trivial weapon as the point of a needle, may, in consequence of their situation, not merely induce serious changes leading to loss of sight in the eye injured, but sympathetically cause such implication of the other eye as to produce total blindness. The knowledge of this circumstance frequently leads the surgeon to urge the sufferer to submit to the removal of the injured, to preserve the sight of the sound eye.

Until the surgeon is seen in all cases of injury the less that is done the better. A light pad of cotton wool may be applied over the closed lids and kept in position by a handkerchief, or if opportunity for the application be at hand, a pledget of cotton wool soaked in *cold* water reapplied *cold* at least every five minutes may with advantage be employed.

Time, however, fails me to enter more fully into such matters, and I must hasten to an end. Let me therefore in conclusion refer

to an expressed opinion of an old teacher of mine own, for whose memory I entertain the profoundest respect, that most amiable of men, accomplished of chemists, and charming of lecturers, George Wilson.

In an admirable little work entitled "The Five Gateways of Knowledge," he draws a comparison between the misfortune of one who has lost his sight and one who has lost his hearing. He maintains that the latter is the severer misfortune, but in this I hold he is mistaken. The instances he selects are Milton and Beethoven. Now, as music was what Beethoven's soul delighted in, and the pleasure from that was for ever dissipated by the loss of hearing, whereas Milton's happiness was not so intimately connected with sight, the instances chosen are not exactly parallel; but still let us compare the effects of the loss of these important senses in them.

There is certainly a peculiar sadness in the spectacle of the old musician playing over his glorious compositions and only fancying their wondrous harmony. Still he could look around him and observe the grand beauties of nature, and read in the eloquent countenances of his hearers the effects his music produced; while blind old Milton saw not this beautiful world which he could so intensely appreciate, and could only judge by the feebler eloquence of words, the power of his song. Listen to his own description of the dreadful blank that blindness may produce, in his description of Samson bereft of sight and in the power of his enemies, and think which is the greater evil:—

But chief of all,
Oh loss of sight, of thee I most complain!
Blind among enemies, O worse than chains,
Dungeon, or beggary, or decrepit age!
Light, the prime work of God, to me is extinct,
And all her various objects of delight
Annull'd, which might in part my grief have eased,
Inferior to the vilest now become
Of man or worm; the vilest here excel me:
They creep, yet see; I, dark in light, exposed

To daily fraud, contempt, abuse and wrong,
Within doors, or without, still as a fool,
In power of others, never in my own;
Scarce half I seem to live, dead more than half.
O dark, dark, dark, amid the blaze of noon,
Irrecoverably dark, total eclipse
Without all hope of day!

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MINOR AILMENTS AND THEIR TREATMENT.

By CLAUD MUIRHEAD, M.D., F.R.C.P.E.

Senior Ordinary Physician to the Royal Infirmary—Lecturer on Clinical Medicine.

In using the term "minor ailments," I am desirous, at the outset of this lecture, that you should entertain a just conception of the phrase; and that neither, on the one hand, should you attach too little importance to the ailments therein included, nor on the other should undue weight be given to them. I wish you to bear in mind this fact, that, *occasionally*, these indications of departure from the condition of perfect health, of which the sufferings arising from the minor ailments are the evidences, prove to be the first warnings of very grave disorders; though, much more frequently, with the cessation of these symptoms and discomforts all danger has passed, and the return to the usual condition of health is established. The one important point to be deduced from this statement is, never to ignore these gentler warnings of deranged health, however slight they may be.

What are we to understand by minor ailments? These may well be defined as the first departures from a condition of perfect well-being, which I suppose all of us have, at some time or other, experienced in our own persons. And these consist, it may be, in some disordered condition of the blood, or in some alteration in the quantity or quality of the nutritive fluids, or in some disturbance in the nerves which preside over the due distribution of these, but all of which disturbances are temporary and of short

duration, and are soon rectified by nature, aided or unaided, the individual again regaining his state of comparative health.

We all, I doubt not, have met with men who, with legitimate enough pride, announce to us that they were never ill for a day in their lives, that they were never a day off work, or that they never knew what it was to have a headache. This is certainly a state of health for which such individuals can never be sufficiently thankful, and a boon for which they ought to be most grateful, though I fear it is only too true in this, as in other common every day blessings, that it is only when it begins to fail us that we begin rightly to appreciate its true value. And yet, I fancy, that even those strong and robust persons must confess to having at one time or other experienced some degree of unusual fatigue, not altogether to be accounted for by the work of the day; to having felt less vigour, less refreshed than usual on getting out of bed in the morning after the night's rest, or even to having passed a comparatively sleepless night; to an indisposition to go to work, and when at it, to feeling that it is performed with less energy, less pleasure, that it has really become a labour or a burden. Now, these are simply some of the ways in which nature indicates that some derangement of the system has occurred, it may be some very trifling alteration or deficiency in the secretions. It is a minor ailment.

Others there are again who hardly know what it is to get through a day without suffering, who pass unquiet, restless nights, who are the victims of headache, who are afflicted with such delicate stomachs and difficult digestion, that they dare not make use of the ordinary fare of which their neighbours partake, without suffering acute agony for hours. Some again there are whose nervous system appears to be so highly strung, that the petty annoyances and worries, which every man inevitably meets with in the pursuit of his ordinary avocations in life, suffice so to pervert or alter the usual physiological conditions of their system, that, from being bright, cheerful, intelligent companions, they gradually become irritable and morose, they shun society, and are disposed to retire to the seclusion of their own private sanctums,

intrusion into which they usually resent. Such men are not pleasing companions as a rule, and this they themselves are perfectly well aware of. Unfortunately this very knowledge only tends to intensify their dislike to mingle in society, and to render them less sociable. These are the victims of minor ailments.

The number of these minor ailments is so large, that the time allotted to us to-night will only permit me to glance at a few of them. I shall therefore, this evening, advert to the more general of them. And first, I shall speak of one of the most universal, viz.,

Catarrh or "Common Cold."

I suppose every one here has, at some time of his life, experienced the effects of a cold; and some of us, unfortunately, are very liable to a recurrence of this unpleasant affection, on the slightest provocation or indiscretion. You have already heard in this place, on another occasion, what dangerous results may flow from an unheeded cold. I shall therefore not delay over this part of the subject. I shall only remind you of certain conditions of the system which render those who are more than others predisposed to the frequent recurrence of catarrh, susceptible to its influence, in order that they may, if possible, avoid placing themselves in those circumstances.

Thus, it is matter of everyday experience, that a catarrh or cold is induced by any debilitating influences, however brought about, it may be by previous illness; or by over fatigue in following too closely the legitimate occupations of daily duty; or excessive study; or undue bodily exertion in pastimes, as football, cricket, lawn-tennis, dancing; all of which, excellent in themselves, when carried to the point of exhaustion, and more especially when the body at that moment, bathed in perspiration, is suddenly exposed on the return home to the sharp keen air of a frosty day, or the chilling atmosphere of a damp muggy night, almost inevitably initiate a cold.

Another fertile cause of cold attacking susceptible individuals

is, the imprudent change of dress. This is almost sure to be the penalty which the young man has to pay who discards some of his underclothing in the early spring, because there happens to be one unusually warm day in the month of March. He, feeling oppressed, becomes intolerant of the heat, casts off the protecting under-shirt, quite forgetting that the chilly month of April and the changeful May have to be passed through before we, in this northern climate, can with impunity adopt the lighter dress of summer. The old proverb is as applicable now as ever—

> "Let May be in and out,
> Before you e'er put off a clout."

The fact is that no one should, even in summer, dispense with the use of flannel next the skin, or some substitute such as merino. It is as important at that period of the year, as in winter.

Another cause, and this refers specially to children, is the exposure of their warm bodies, when asleep, to the cool air of the bedroom. They unconsciously throw off the bed-clothes, and if these be not speedily replaced, the result frequently is a cold. While on this subject, I may remind you that, occasionally, this throwing off of the bed-clothes by the children is more rational than it seems. Through the over-solicitude of the mother or nurse, who knows the susceptibility of the little one to take cold, the child is laden with an unnecessary supply of blankets, and very probably is at the same time enveloped in a flannel night-dress. Thus the child is oppressed with heat, and naturally endeavours to get rid of some of its burden by tossing off the clothes as often as they are replaced. Over-clothing is really as much to be deprecated as the reverse.

These, and many others which will readily suggest themselves to you, are frequent causes of catching cold. And the remedy against this very unpleasant ailment is obvious enough from what has just been said—avoid the cause.

I suppose that in so very common an ailment as "a cold," I need hardly detain you by describing its symptoms. Every one

knows from his own experience the feeling of languor and discomfort which is discovered at the outset of a catarrh, the chiliness, the feeling of cold creeping down the back, the heaviness and occasionally pain in the forehead, the difficulty of breathing through the nose, "the stuffed head," as it is called, and the accompanying nasal twang of voice. Soon there follows a thin acrid discharge from the nostrils, the eyes are heavy and watering, and towards evening a little feverishness sets in, with increased pulse. The catarrh may either stop there, or may pass to the throat, giving rise to pain, hoarseness, sore throat, and cough; or extending further into the windpipe, there is now discovered some difficulty in breathing, a sense of tightness or rawness under the breast-bone, and perhaps some wheezing. The cough is painful, dry, harsh, and frequent, being kept up by a feeling of something irritating or tickling the windpipe. Soon, however, the cough brings up some mucus, and with this expectoration there is usually experienced a sense of relief from the constriction and rawness in the chest. The discharge from the throat and nostrils gradually changes in character, becoming thicker, less acrid, and more abundant, and with this change all the other symptoms abate in severity, and in four or five days the sufferer is comparatively well again, though perhaps he may be left a little weaker than usual for a few days more.

This is the ordinary course of a common cold, when it attacks a robust, healthy man. The usual termination is in recovery. But, unfortunately, it is not only the strong individuals who are the subjects of catarrh, but it also lays hold of the delicate and weakly persons; and the termination of a catarrh in their case is by no means so rapid, nor so satisfactory. It may only prove to some of them the prelude to much more serious and lasting disease. For information on this subject, I cannot do better than refer you to that valuable and interesting lecture which Dr Affleck delivered to you last year.

Now if this be a possible termination of so minor an ailment as a common cold, it behoves every one to take some trouble to

get rid of it. Let no man ignore a simple cold if he be wise, more especially if there be any delicacy in his constitution. Neither let a man attempt to "walk it off," as the saying is. By so doing, he is only still farther exhausting his strength, which is already weakened by the inflammation of his mucous membranes, and thereby rendering recovery more tedious. If from experience gained from former attacks, the patient be aware that he has "caught cold," then occasionally it may be arrested, in the first stage, by taking, at the very outset, a hot bath on retiring to rest, with ten grains of Dover's powder at bedtime, followed by a hot drink, such as a basin of hot gruel or a tumbler of hot toddy, with a dose of castor-oil in the early morning about six o'clock. It is well to remain indoors for the day. Should, however, these means fail, or the ailment have progressed too far before the remedy is applied, and the patient complain of soreness of chest, with cough and feverishness, then he must keep bed for three days. Mustard and linseed poultices are to be applied to the chest, warm diluent drinks are to be given, such as gruel, with honey and vinegar in it, to promote gentle perspiration, and to relieve the severity of the cough. Ipecacuanha wine, in ten or fifteen drop doses in water every four hours, will be found useful in promoting the expectoration. Laxative medicine will probably be necessary, and the diet should be light.

I will only further remark on this subject, that the most effectual means of enabling one to resist those frequently recurring colds is, to keep the body in the highest state of health. And one most excellent preventive is a bath in the morning, immediately on rising from bed. If the individual be sufficiently robust to bear it, let the bath be cold; and the test by which to know whether the cold bath be beneficial or not is, the sensation of a warm glow which overspreads the surface of the body, immediately after the drying operations are concluded. Should the skin remain chilled and pale, then the water has been too cold, and the addition of warm water becomes necessary. By the robust, a shower-bath may be indulged in in the morning; and should this

prove too severe a shock to the system, and to many this is much too great for them even to risk, then it may be modified by standing in tepid water while taking the shower. Without doubt, it needs considerable resolution and courage for a man in a dark frosty morning to step directly from bed into a bath, and deliberately pull a string, which immediately results in a deluge of cold water over his head and his warm body. Of course the first shock is the worst; but when that has passed, the bath becomes actually pleasant. And I know of nothing that braces the system more effectually than this cold bathing in the morning, and that more powerfully enables the body to resist the effects of the cold raw air of this climate. The man accustomed to the use of cold bathing, if by chance he be deprived of it, feels miserable and unhappy for the day. He has missed his usual stimulant, and is consequently less vigorous and energetic. Now, while cordially recommending the use of the daily cold bath to the strong, I am desirous that I should not be understood as advising its use indiscriminately. There are many to whom it is not only not beneficial, but actually harmful. And such persons ought always to have the extreme coldness of the water removed by adding hot water, till the temperature of the bath rises to about 50° Fahrenheit. I repeat that the test by which to ascertain whether the cold bath is safe or not, and this applies equally to sea-bathing, is the perception of that agreeable warm sensation over the body on emerging from the bath, and a feeling of refreshment and invigoration, which the healthy man experiences after bathing.

Let me here, for the benefit of my younger hearers, interject a word of caution with regard to sea-bathing. Never plunge into the sea, however tempting it may be in a warm summer's day, when fatigued, or over-heated, or immediately after a full meal; otherwise, you will miss that after-glow which is the evidence of the good effect of bathing. The system is then too debilitated to establish the reaction, and the bather remains chilled, shivery, and depressed, instead of being warm, exhilarated, and refreshed.

I need not tell you, I presume, that young children and infants should not be treated to perfectly cold baths. Infants especially should always have a warm bath, ranging from 85° to 95°. But I must protest against the system, which some mothers and nurses adopt, of using much too hot water. They imagine that they can sufficiently accurately gauge the temperature of the water by the hand. This is a most egregious error. I have actually seen a bath prepared for an infant, into which the nurse was about to place it, which, on testing its temperature by the thermometer, marked 115° Fahrenheit. This is most unfair to the child; for by thus strongly attracting the blood to the skin, in fact producing a temporary congestion of the skin, a corresponding reaction ensues afterwards. So soon as the cool air comes in contact with the body, even though it be clothed, the blood is driven with unusual energy to the internal organs and mucous membranes, by the rapid contraction of the previously largely dilated capillaries of the skin, and there actually supervenes this very condition of congestion of the mucous membranes, the first stage of this catarrh of which I have been speaking. Now, in making use of colder water, there of course is at first experienced a slight shock, which, however, is merely momentary; then follows a period when the temperature of the skin remains lowered; and finally ensues the reddening of the surface, the pleasant glow of warmth, indicating the increased capillary circulation in the skin. This is not merely a temporary effect, but it continues for hours after, thereby relieving the internal organs and mucous membranes of an excess of blood, in this way indirectly stimulating them to perform their various functions more satisfactorily and more actively. Should this reaction be slow to set in, friction to the skin, at first gently, afterwards more firmly and energetically, ought to be employed during the bath. Indeed, for those persons who cannot under any circumstances make use of the bath, dry friction, applied to the skin by means of a hair-glove or flesh-brush, will be found to be a most valuable substitute.

Cough.

This, as we have already seen, is an almost invariable accompaniment of bronchial catarrh. Indeed, cough cannot be regarded as a distinct ailment, however harassing and prominent it makes itself. It can only be regarded as a *symptom* of some affection.

The act of coughing, as you are aware, is an effort made to get rid of something which is irritating the windpipe. The mechanism by which cough is produced is somewhat complicated, though the act appears simple enough. It is effected by the individual taking a full breath; the glottis, or upper portion of the windpipe, is then closed for a second; and finally, it is suddenly burst open, with considerable noise, by the expiratory effort of the air confined in the lungs, aided by the pressure of the abdominal and thoracic muscles. In this way considerable force is exerted, and in the suddenly expelled stream of air any mucus, or other offending matter, is ejected from the bronchial tubes into the mouth.

Cough, as I have said, is a symptom of disease, and is often sufficiently characteristic to indicate the nature of the affection of which it is the attendant. Thus every mother knows the peculiarly harassing, violent, long-continued spell of coughing which occurs in hooping-cough, ending in the long back-draw or whoop. And in like manner, the experienced physician is often able to tell the nature of the affection, by listening to the sound of the cough, and to refer it to its proper source.

But after the original cause which excited the cough has been got rid of, it frequently enough occurs that a sensitiveness of the mucous membrane of the throat remains, and any slight irritation, such as the inspiration of cold dry air, may give rise to a fit of coughing. Even the repeated act of coughing keeps up the irritability of the mucous membrane; and just as scratching of the skin begets scratching, so coughing begets coughing. The individual gets into the habit of coughing, and makes no effort to restrain it. How pernicious this is to the individual himself I

have already shown; but worse than this, he becomes a serious nuisance to his friends, for which there is no excuse. And this habit of coughing is peculiarly catching, as must be evident to every one. If any one doubts it, only let him note it the next time he goes to church, where occasionally the noise arising from this cause is, as distracting, as it is unnecessary. I know of nothing more annoying or more irritating to a public speaker than to have, perhaps, some of his finest perorations drowned by this useless noise. Coughing, let me insist upon it, is greatly under the control of the will, and children ought to be taught to try to restrain the inclination to cough; and very often, by this very effort, the desire to cough will vanish. And if it cannot be avoided, they should be taught *how* to cough. It is not in the least necessary to give way to coughing on every occasion, even though there be really something to expectorate, until the mucus or other irritating matter be within easy reach, and then one good, effective, deliberate cough will do as much, or probably more, for the relief of the individual, than perhaps a dozen of repeated, noisy, resultless fits of coughing.

Then as to the noise which accompanies the act, this can be greatly modified at the will of the individual. But there are some people who make not the slightest effort to lessen this annoyance, and look upon one as heartless, and wanting in feeling if he venture to suggest that a little less noise, in the unavoidable act of coughing, would be to the advantage of the other patients, say, in the ward of the hospital. In many cases the mouth may be closed, and in all the hand may be held before the mouth during the act. In this way considerable modification of the noise may be attained. When coughing is unavoidable, one cannot but sympathise with the sufferer, and endeavour to alleviate it; but where it is a mere trick or nervous habit, one can have small tolerance for it; and such persons ought not to be permitted to go into public assemblies, to make themselves a nuisance to their neighbours, until they have learned to control this nervous irritation.

From what I have said you will have gathered that cough is

not an ailment to be treated *per se*, but is one of the symptoms of other affections which will call for attention in the management of them. I would caution you, therefore, against making use of any of those nostrums which are vaunted as a cure for all sorts of coughs and colds. They mostly all contain opium in some form. They may give relief to this symptom, but they may prove prejudicial to the real complaint which initiates the cough. At the same time, it is a very distressing symptom, and urgently calls for amelioration. There never can be harm in causing the patient to inhale steam of hot water from a sponge, or basin of boiling water. Or infusion of hops may be made, and inhaled. Then lozenges of various kinds are often useful, *e.g.*, fruit, gum, glycerine, liquorice, marsh-mallow, tamarind, ipecacuanha, &c. Linseed-tea is a bland, soothing demulcent, useful in sore throat, and in allaying tickling cough. It is made by taking one ounce of linseed, one ounce of white sugar, half an ounce of liquorice-root, four table-spoonsful of lemon juice, and adding to these two pints of boiling water. Let the mixture stand for four hours in a warm place, then strain, and it is ready for use.

Sore Throat.

This is a constant accompaniment of some very serious disorders, such as scarlet fever, measles, small pox, diphtheria, &c. With these forms of the affection we have nothing to do. They lie outside the scope of this lecture. That form of sore throat in which we are specially interested to-night is, most frequently, the result of exposure to cold and damp, when the body is heated. It may be confined to the parts situated at the back of the mouth, *i.e.*, the tonsils, palate, and pharynx, or it may extend a little further into the windpipe. The affection is an inflammation of the mucous membrane of the parts enumerated.

The most prominent symptom is, soreness. This is most evident when attempts at swallowing are made. Even the effort of swallowing the saliva gives rise to pain. On inspecting the throat it is observed to be red, tumefied, swollen, and instead of being

moist it is probably dry, and possibly there may be seen some mucus adhering to the membrane. Most likely the voice will be altered in tone, or it may even be lost. Cough is pretty sure to be a symptom; and it is usually frequent and painful.

Most of these cases speedily recover without any active treatment, provided the invalid will have patience for a few days. All that he need do is to confine himself to the house, better to one apartment, and still better to bed, for a couple of days; to avoid all conversation; to apply a warm poultice to the throat; or a moist compress may be worn around the throat night and day. This is made by wringing a piece of lint, or a pocket handkerchief, out of water sufficiently so that it does not drip, and it is of small moment whether the water be cold or warm; it is now applied to the throat, and covered with a piece of macintosh, and then a woollen comforter is put over all. Ice may be sucked continuously, if agreeable to the patient. If it be not, then a gargle of warm milk and water should be employed every hour. A smart aperient dose of Epsom salts or castor oil should be taken in the morning before breakfast, *i.e.*, one tablespoonful of salts in a tumblerful of hot water. If, under this treatment, the throat do not improve in two days, it has ceased to be a minor ailment, and the physician must be sent for.

Another variety of sore throat is that which is known by the name of

Quinsy,

or inflammation of the tonsils, two glands situated at the back of the mouth. These glands, both from their position and their peculiar structure, are unusually liable to participate in all affections of the throat. This inflammation of these structures is principally observed in changeable climates; and seems to attack, by preference, young adults. Children rarely suffer from quinsy; and it is well known that persons, who have once been the subjects of this ailment, are very liable to a recurrence of the disorder. It is also asserted that persons of rheumatic constitution are

frequently the subjects of attacks of tonsillitis. The most common exciting cause of quinsy is, exposure to wet and cold, with a chilly east wind; tolerably frequent concomitants in this city.

The symptoms which usher in the approach of a quinsy are usually manifested by indications of fever. This is preceded probably by chilliness, or even by decided shivering. The patient then becomes restless, irritable, and hot. He complains of general weariness and soreness, as if he had been beaten. He has headache, and, if young, may even become delirious at night. The tongue, a good indicator of the state of the general system, more particularly of the digestive system, is covered with a thick, dense, yellowish coating; the breath is heavy, and of peculiar odour. The voice is altered, becoming indistinct, thick, guttural, and nasal. The mouth is opened with difficulty, and swallowing is attended with much pain, even of the saliva, so that it is often allowed to flow out of the mouth. Respiration is impeded, being noisy during the day, while at night the patient snores during sleep. Occasionally he may become deaf.

The first indication of uneasiness in the throat is a complaint of pricking and dryness in the region of the tonsil, soon passing on to actual soreness, and pain of a dull character, which shoots up towards the ear on the affected side. Externally, some swelling may be observed which is painful to touch. On inspecting the mouth, one tonsil, rarely both, will be observed to be considerably swollen, and of a bright red colour, with perhaps some patches of yellowish secretion adherent to its surface. The soft palate and uvula are œdematous and swollen. This state of matters may continue for four or five days, gradually increasing in severity, and then the inflammation may slowly begin to subside, and finally disappear in ten days, after which time the patient may again be able to resume his usual employment. Frequently, however, the process runs on to suppuration, in which case the symptoms become aggravated, the swelling and pain increase, swallowing becomes nearly impossible, breathing is seriously im-

peded, speaking is not attempted, and altogether the sufferer is in a deplorable condition. But precisely when matters have reached this pitiful state, the abscess bursts spontaneously and unexpectedly. Relief is immediate, with the discharge of fetid pus, and convalescence is speedily established.

Those who are liable to this form of sore throat, and who know from the premonitory symptoms what is impending, ought at once to adopt measures to try to prevent it going so far as I have described. These, though unfortunately not always successful, consist in using strong astringent gargles; in the administration of single drop doses of tincture of aconite, every hour, for half a day, and a brisk saline purgative in the morning, such as a dose of Rochelle salts. For gargle, one of the best is the old fashioned homely mixture, consisting of three tablespoonsful of red wine (port or claret), one of vinegar, half a teaspoonful of powdered alum, and a little sugar, in a tumbler of cold water. This to be used every hour. If, however, the affection has gone too far for this abortive treatment, then the patient must be confined to bed; hot poultices must be kept constantly applied to the throat; steam from hot water should be inhaled often; a gargle of hot milk and water should be used hourly; and ice, if grateful, may be constantly sucked. A sal prunelle ball may be allowed slowly to dissolve in the mouth. The diet should be given in semi-solid form, *e.g.*, arrowroot made with milk, soup thickened with rice-flour, or better still, beef-jelly, if the patient can be persuaded to swallow at all. If the abscess do not speedily rupture, and more particularly if both tonsils be simultaneously affected, then it may be necessary to call in the aid of the surgeon to lance it. The necessity for this will be evident by the continued and increasing distress of the sufferer, the great difficulty in breathing, and the extreme restlessness and feverishness of the patient. In a first attack, too great delay ought not to be allowed to take place before asking the assistance of the surgeon.

Rheumatism.

This is a disorder almost as general as a common cold, and is particularly frequent in cold damp places. In fact, so prevalent is it in some districts that the term "rheumatic" has been applied to it, either because of the great number of inhabitants so afflicted, or because a new comer to such district is pretty sure to become a victim to this painful affection. But it is not by any means confined to certain districts. Everywhere, in this cold, damp, variable climate of ours, we find numerous examples of it. Neither is it confined to persons of any special rank in life, but in every class of society, in both sexes, and at all ages, you find people complaining of this unpleasant ailment. And the worst of it is, that when once it has fairly laid hold of an individual, he is never sure when he may be free of the enemy. It has a most unpleasant faculty of returning to visit its old haunts. The fact is, that one attack, so far from giving immunity from a second, as is the case in many of the acute infectious disorders, seems to predispose to the onset of another.

There are varieties of this disorder—the acute, or rheumatic fever, the subacute, and the chronic. About the first two I have nothing to say this evening. They are major ailments, and the acute variety often leaves behind it serious effects and a damaged constitution. It always demands most careful supervision of the medical attendant.

As most people are aware who have suffered from rheumatism, the parts of the body most commonly selected for the attack are the joints, muscles, and fibrous structures, and unfortunately for the patient, these attacks which give rise to so much pain are often most troublesome at night, and interfere most materially with the night's rest. There is, however, another form of chronic rheumatism which, on the contrary, is characterised by the affected parts feeling somewhat cold, as well as stiff and painful, and which sensations are much aggravated by damp cold weather, and are relieved by warmth and the heat of the bed. This variety is spoken of as cold rheumatism.

The two grand characteristic symptoms of chronic rheumatism are, pain and stiffness. These are felt either in the joints themselves, or in the structures more immediately implicated in their movements, or in the muscles. So severe and so long continued are these affections of the joints, that ultimately they become enlarged, disorganised, and distorted. The poor sufferer becomes helpless and bed-ridden; his general constitution is entirely shattered; he becomes emaciated, anæmic, and debilitated; in fact, he is a helpless cripple. Examples of these unfortunate victims of chronic articular rheumatism may be met with in every workhouse infirmary. This condition is brought about by repeated attacks of the subacute variety, one probably succeeding the other at such short intervals, that the patient has barely recovered from the first attack, before, apparently without any assignable cause, he is laid down again with another of probably equal, it may be even greater intensity; until, finally, he is really never free from this harassing, distressing pain.

But happily rheumatism does not always proceed to such lengths; and although certain persons suffer severely enough from their articular pains, they always experience intervals, of varying length, of complete immunity from their aches and pains. In such cases the affection is usually limited, at least, for a long time, it may be years, to one joint. The pain experienced is of a dull aching character, varied with occasional severe twinges; the joint becomes swollen and tender to touch, the limb feels heavy; there is manifest disinclination to make use of it, for movement of the joint greatly aggravates the pain. This is usually worse in bed; but if the patient could only be persuaded to permit movement of the joint to be made for him, he would soon discover that, after the first immediate aggravation of the pain had subsided, he was able to move the limb with comparative ease and freedom from pain. The stiffness and pain are materially relieved by this passive movement of the limb. Very often, when the joints are not the seat of pain, it will be observed that they have a tendency to creak when particular movements of them are made, and they feel stiff and dry.

There is another variety of rheumatism which seems to locate itself in the muscles and fibrous tissues, usually spoken of as muscular rheumatism, where the joints are comparatively unaffected. This is the variety which commonly affects children, not that they are by any means exempt from the acute form, and which exhibits itself as "growing pains," stiff neck, wry neck, lumbago, chest pain, or pleurodynica, &c. Of course such persons seem to have either inherited or acquired the rheumatic constitution, that is to say, that they exhibit a peculiar predisposition to be affected with these muscular pains, when subjected to any of the known causes which give rise to rheumatism, but which same causes do not, in like manner, produce such pains in those who are not so predisposed. Thus, suppose two persons to have been exposed, perhaps at the same moment and in equal degree, to a thorough wetting, to a draught of cold air playing upon the body, to a chill, after being heated, and it may be when the body is perspiring, or to have incautiously thrown themselves at full length on the damp grass, when fatigued. The one individual may rise from the ground refreshed and ready for several more hours' hard work, while the other gets up, feeling less weary, perhaps, but stiff and sore all over, with considerable pain in his back probably, which occasionally amounts to spasm, and is increased when he attempts to straighten himself. This last man is now affected with the minor ailment termed lumbago. He being predisposed to be attacked by rheumatism, inheriting the rheumatic constitution, is seized upon by the enemy when he is off his guard, and forgets about his proclivity. Such persons ought on no account ever to stretch themselves on the damp ground, or even to sit upon what appears to be perfectly dry grass, if they desire to avoid an attack of this nature. They cannot afford to take such liberties with themselves in our humid climate, with impunity.

The symptoms indicative of this muscular form of rheumatism are usually manifested by pain in the muscle specially affected; at least, this is the prominent one, and the symptom which bulks most largely in the patient's estimation. But without doubt, for

a day or two previous to the attack, the individual has been "out of sorts" as the phrase runs, has perhaps been a little feverish at night, less disposed for food, and may even have complained of a little soreness of throat. There is a general feeling of lassitude, and finally the pain centres itself in some definite locality; it may be the neck, the chest, or the loins, &c. This pain is at times of great intensity, and greatly interferes with the freedom of movement. Should it locate itself in the muscles of the chest, then the pain is at times excruciating, and embarrasses the respiratory movements, so that the individual fears to take a deep breath, in consequence of the acute lancinating pain to which such procedure gives rise. To cough is agony to such patients, and hence it is a restrained, short, catching cough. Frequently, the patient discovers that, by lying upon the affected side he is in a condition of comparative ease and freedom from pain; the fact being that he, thereby, materially lessens the movements of the chest wall, and thus, of course, relieves himself. And hence one of the easiest and satisfactory means of treatment in this form of rheumatism, viz., to apply a flannel bandage, pretty tightly, round the chest, in order to restrain the movements of the chest wall. Soothing liniments may also be applied to the side, such as belladonna and chloroform liniments, mixed in equal proportions. Or more stimulating ones may be called for, as the liniment of turpentine, or oil of cajeput mixed with olive oil.

When the rheumatism locates itself in the muscles and fibrous structures of the loins, it is spoken of as *Lumbago.* The pain in the back is the leading feature in this affection, the intensity of which varies in each case. Some persons are able to go about their daily avocations though suffering considerable pain, and compelled to assume awkward attitudes to avoid putting the affected muscles on the stretch; while others, again, cannot raise themselves from the horizontal posture, without inducing most acute pain in those muscles which are called into action when one elevates himself to the erect posture. To raise one self, after stooping, produces a spasm of the muscles and tendonous structures, so intense, as to elicit from the sufferer a strong expression

of his agony; and to avoid the pain, which, from experience, he knows is produced by sudden movements, or even by the attempt to turn himself in bed, he makes use of the strangest devices, and assumes the funniest contortions; so that the bystander, even at the risk of being branded as the most unfeeling of friends, cannot resist the provocation to laughter thereat, much to the chagrin of the invalid, who finds it truly no laughing matter. Happily this, though a sufficiently trying affection, is not a dangerous one. The remedies which have been proposed for the relief of this rheumatic affection are numerous enough. Some of the homely ones are by no means to be despised, such as ironing the back with a hot smoothing iron, of course with the interposition of a double layer of flannel between the skin and the iron. I have found that the efficacy of this treatment is heightened by wrapping the flannel round the hot iron, and moistening the flannel with vinegar. The iron, thus guarded, is to be left in contact with the skin for a quarter of a minute, at various points. Another good remedy is the application of turpentine stupes to the back. This is effected by taking a doubled piece of flannel, say 12 or 14 inches long by 8 or 10 inches wide, and dipping it into boiling water. It is then wrung firmly, and turpentine is sprinkled liberally over it. This is applied to the loins, and kept on for twenty or thirty minutes. When removed, cotton-wool is to be applied to the skin. At the outset, a strong effective purge ought to be taken. Should these simpler measures fail, then it will be expedient to apply for skilled advice. The wearing of a band of silk round the waist has been recommended as a prophylactic, and enjoys considerable reputation as a protective of some value. I have myself been convinced that this is really effective, in some cases, as a protective measure. And the only way in which I can imagine it to be of use is, that the silk, being a non-conductor of electricity, prevents the body-electricity from being too quickly discharged. This, however, is a mere theory, and I do not put it forward as the scientific explanation.

Others, again, who believe themselves to be rheumatic, never

suffer from any of these severer forms of rheumatism which I have just described; yet they are constantly complaining of various ill-defined flying pains, which flit from place to place with remarkable capriciousness, never very long persistent, but which make them very unhappy and very miserable. These are justly enough termed rheumatic pains. And it is noticeable that these pains are usually much aggravated by certain changes of weather; especially during the course of an arid east wind, in thick foggy weather, or when a "haar" prevails. Then, these unfortunate people come home feeling weary, irritable, and stiff, complaining of decided aching in the back, the loins, arms, or legs; often indeed they are hardly able to localise the spot where the pain is worst, it is so general. They are generally miserable, feel pinched, weary, and ill all over. The best thing for such a person to do is, to get as speedily as possible into bed, between blankets, after taking some very hot drink, soup, tea, water even, as hot as can be borne, in order to induce free perspiration.

So soon as this is established, the individual passes from a state of intense discomfort to one of comparative ease and well-being. This condition of comfort would be more quickly brought about were the patient to take a hot bath, of a temperature of 104° Fahr, and remain in it till perspiration be induced; then, having quickly dried the skin, he should get into bed, between blankets, to encourage this moist condition of skin.

Those persons who are subject to these short attacks of rheumatism, will often discover that they are associated, if not actually dependent upon, some derangement of digestion: such as acidity, flatulence, and distension after eating (more especially after partaking of certain kinds of food), heart-burn, eructations of gas, &c. Occasionally, it will be observed that, an attack is induced by a single glass of beer or champagne. It is very evident that these wandering rheumatic pains are, in such cases, actually initiated by the food received into the stomach, because the effect is so immediate; that is to say, those pains are developed within an hour or two after partaking of the offending aliment. It is quite likely that the blood was already

in such a condition, that it required very little more addition of the deleterious material to develop the pains—the blood was, probably, already so overcharged with the effete products of disintegration of the tissues—that a very small increase proved sufficient to determine the rheumatic pains.

Now, the most important matter for those who suffer from rheumatism is, to learn how they may best prevent the accumulation in the blood of those matters, which tend to develope this painful condition. To effect this end, it is of the utmost consequence to see to it, that the three great channels by which effete matters are carried out of the system are kept in good working order—I mean the skin, the bowels, and the kidneys. If this be not attended to, an accumulation of waste products takes place in the blood. These undergo certain chemical changes, and among other products lactic acid is probably formed in excess, which gives rise to much of the discomfort known as rheumatism.

I have already indicated to you certain of the methods by which the action of the skin may be encouraged, viz., by the use of the hot bath. By its use, free perspiration may be induced. The Turkish bath and the hot air bath are other means. This latter is very easily extemporised by placing a lighted spirit lamp under a cane-seated chair; on this the patient sits, already unclothed, and he is then enveloped by blankets and other coverings from the neck. This hot air bath speedily induces a large amount of perspiration, even more than the hot vapour bath; as, in this latter case, the free transpiration from the skin is somewhat impeded, by the deposit upon it of the watery vapour. If, however, it be thought desirable for any reason to employ the vapour bath, this may be as readily and simply arranged in the bedroom, as the apparatus for the hot air bath. In this case, instead of the spirit lamp being introduced below the cane-seated chair, a foot pail is made use of, in which is boiling water to the depth of four or five inches, and into this is placed a brick, previously heated to redness in the fire. By this means, a rapid development of hot steam is effected, the skin and blood heat are raised very greatly, more so than by the hot air bath, the

result being a profuse flow of perspiration, which relieves the blood of various salts and other effete matters, which it is desirable to be rid of.

In using the hot bath—and the temperature of this should be about 104° Fahr.—it may be advantageous to make it an alkaline bath. This is readily accomplished by adding about six ounces of carbonate of soda (washing soda) to the bath before entering it. And this will be found to be specially efficacious if there be much stiffness of the joints or muscles.

In addition to the use of baths, there are many drugs which have the effect of inducing free perspiration, *e.g.*, the solution of acetate of ammonia; opium alone, and in combination with ipecacuanha; antimony; and most speedy of all, jaborandi, or its active principle pilocarpine. But these should only be employed under the guidance and direction of the medical attendant, with the exception of the first named, the solution of the acetate of ammonia, which may safely enough be made use of as a household remedy in tablespoonful doses freely diluted in water. This is the dose for an adult.

The bowels may be acted upon by any mild aperient, and preferably by the salines, *e.g.*, Epsom salts; in half-ounce dose Rochelle salt; effervescing citrate of magnesia; any of the mineral waters, as Hunyadi, Carlsbad, Friederichshall, or Æsculap waters. Two important points to be observed, when using saline aperients, are; that they should be taken largely diluted in hot water, and early in the morning, before any food has been partaken of.

The third channel by which waste products are eliminated from the body is, the kidneys. Their action ought to be kept up, and if somewhat sluggish, it ought to be stimulated, by the proper class of remedies, namely diuretics. The simplest of all is water. A tumbler of hot water drunk slowly in the morning, while dressing is going on, will be found to be the least harmful, the least unpleasant, and a very efficient renal stimulant. Should this not prove active enough, it may be rendered more energetic by the addition of a teaspoonful of cream of tartar. A favourite household drink, and a very good one, is imperial pop. It is

made by throwing a tablespoonful of cream of tartar into a pint of hot water, adding the juice of a lemon and sugar to taste. It is then strained, and used when cold. Sweet spirits of nitre, in teaspoonful dose, in a glass of water, is another good renal stimulant, and may be used occasionally. Milk, barley water, and such like gentle diluents can never do harm, and may be used in any quantity.

Alkalies are almost always useful in relieving rheumatic pains. Bicarbonate of potash, or soda, may be freely enough made use of, provided that they are not taken continuously, for an indefinite period of time. Either of them may be taken in dose of half a teaspoonful, in half a tumbler of ærated water, twice daily, for about three weeks or a month at a time. Another good method of making use of the alkali is, to add to the soda or potash the juice of one lemon, and pour over this a tumblerful of ærated water, to which, if thought desirable, a pinch of sugar may be added. This mixture may be taken twice daily, for about ten days at a time. This will be found to be a most agreeable and refreshing drink, especially in hot summer weather.

The diet of those who are of the rheumatic habit of body ought to be restricted, as regards certain articles. Thus, butcher's meat ought to be rarely partaken of. The lighter forms of solid food are more appropriate to such persons, *e.g.*, fish, soups, chicken, milk-puddings, vegetables, fruit, milk. Beer and wine ought, as a rule, to be avoided. Ærated waters may be partaken of freely. Much smoking, particularly of heavy tobacco, is prejudicial.

As already mentioned, persons who suffer from rheumatic pains ought always to wear flannel next the skin. It protects the body from being suddenly chilled, after it has become moistened with perspiration. And let me give this last caution, let no rheumatic individual complain of this tendency to perspiration; and above all, let him beware how he attempts to stop this action. It is nature's method of relieving him of still more unpleasant evils, and so far from using means to put an end to it, the patient ought to bear with it, and rather encourage it. The sweating will gradually diminish in time, and the individual will probably then

find that he is better in health, and freer from his rheumatism than he has been for a long time previously.

But now, I have tried your patience sufficiently long. As you see, I have only been able very imperfectly to glance at one or two of the minor ailments, and to give some hints as to their treatment. To give a slight sketch even of the more important of these would occupy many lectures, and that I fear would prove a little trying to your good nature. I trust, however, that what has been said to-night may be of some use to you.

NURSING THE SICK.

By J. HALLIDAY CROOM, M.D., F.R.C.P.,
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Ladies and Gentlemen,—I am to suppose that you have got some one very ill, and that you are desirous to get him well again as soon as possible. You must not imagine that you have done all you can when you have brought a doctor to him and got a bottle of physic. Both of these are important, perhaps both are absolutely essential, and yet there is a great deal more you can do to help in bringing back health and strength to your patient. It may be that recovery is hindered by want of fresh air, light, warmth, cleanliness, quietness, rest, and proper food. All those things you have in your power to bestow, and all those go to further his recovery, and constitute proper nursing just as much as making a poultice or a bed. The three great factors of life are—air, heat, and nourishment, each and all are essential to life, and deprived of them, ill-health, tardy recovery, and death are the result.

Now I wish to point out to you that these three factors are almost entirely in the hands of the nurse who is constantly with the sick person. It will be apparent to you how much she can do, either to hasten the sick person's recovery or his death, by the right use she makes of these powerful remedies.

Now let me suppose that you have the charge of a sick person. Let me say a few words with regard to the choice of a room. If you have two or three to select from, choose a sunny, light one, looking to the south. See that it has a fire-place, and that its

window opens both at top and bottom. Be sure that you get plenty of sun and fresh air. If the window has curtains remove them. It may be, however, that you have only one room, and that the window will not open. Knock out a pane of glass and across the opening so made stretch a piece of thin muslin, or better still, of perforated zinc. Your next endeavour ought to be to make the room as clean as soap and water can make it. You must brush the walls down and scrub the floor thoroughly clean. To conduce to the freshness and convenience of the room, it will be necessary to remove all the furniture excepting only that which you absolutely require. The fewer things you have in a sick room the better. Even in midsummer a small fire is useful—it helps to ventilate the room, and keep the air fresh. If you do not have a fire, then be sure to leave the chimney of the room open. Do not close the damper, nor stuff the chimney with straw.

If your patient suffer from his head or his eyes, do not let him lie in a blaze of sun-shine or gas-light; but tack a piece of dark stuff across the window, dark blue or green being always better than white.

Air of Room.—The air of the sick room should be kept as nearly as possible at a uniform temperature, always about the same warmth. Nothing can be worse than to have it sometimes very hot, and at other times very cold. Try to avoid having at one moment a large fire and the patient almost suffocated, and at another time the doors and windows open, and the patient shivering with cold. To maintain an equable temperature is, I am well aware, by no means an easy matter, especially in a small room; but care and attention will do a great deal to render this attainable. In respect of this point there is one thing to which I should like to draw your attention, namely, that the early morning hours, between two and seven A.M., are the coldest, and the period at which the vital powers are at their lowest, and, therefore, the time at which serious changes, and frequently death take place. During these hours the patient must be carefully watched, and the heat maintained by extra clothing, hot bottles, and warm drinks, and you must be careful not to allow the fire to burn low. The

neglect of these simple precautions during the early morning hours, "the period of lowest vital intensity," has sacrificed many lives. With regard to air and ventilation, Miss Nightingale has made the following remarks :—That "the great object of ventilation is to keep the air which the patient breathes as pure as the external, without chilling him." It is no unusual thing to find persons in preparing a room for a sick person, careful to stop up every crevice through which air can enter, put bags of straw in the chimney, and shut the windows tight with no intention of opening them again until the patient is well. They labour under the impression that if a breath of fresh air were to get in it would kill him, and they expect, notwithstanding the exclusion of air, that the unfortunate sufferer will get well. Let me positively assure you that he is just being as certainly poisoned as if he were being administered a dose of arsenic daily. An excellent rule is *always* to keep the window open two inches at the top, and besides this, twice a day you should carefully cover your patient well up and open the window wide for five or ten minutes. There is no risk of chilling the patient if this be carefully done: with plenty of covering and hot bottles you can always keep a patient warm in bed. And pray do not suppose that you must shut the window at night. Night air is better and purer than day air, and people require fresh air just as much when they are asleep as when awake. Let me then ask you to make it a rule always to keep the window open a little from the top. One thing more, never try to air the room by opening a door on the stair or passage. By doing so you get worse air introduced into the room. To keep the air of the room always pure, you must have a fresh supply constantly coming in to take the place of that which your patient has used. Let me assure you that you cannot have too much of fresh air; it is certainly one of the best medicines as well as by far the cheapest, and like all other things so obtained is not sufficiently valued because of its cheapness. At the same time you must guard against draughts, and if the room is small, and the bed, as is often the case, between the door and the window, you can very easily make a screen to

keep off the draught by putting a sheet or coverlet over a clothes screen.

Cleanliness of the room. In respect of this you must observe great care. Keep everything in the sick-room scrupulously clean. You should wash, sweep and dust out the apartment daily, and remove at once if possible all soiled and dirty things from it. In performing these little duties, there is no need that you should make any noise or fuss. You can do them all without in any way disturbing your patient. Choose a proper time for their performance, not for instance just when he has dropped asleep after a restless night. So much then for the patient's room. Before, however, we quite leave the subject, let me summarise :—A sunny light room with an opening window, and a fire-place—scrubbed clean—not too much furniture and clothes about—a bed and a window with no curtains—a small fire always burning, windows always down two inches from the top, (not the bottom)—the room never to be aired by opening the door into the passage—the room to be swept and dusted daily—everything soiled to be removed at once out of the room.

Let me now offer a few suggestions with regard to the *personnel* of the nurse herself. A pleasant personal appearance will go far towards inspiring confidence, and can be secured by a little neatness in dress. Trailing skirts, loose hair, and all jewellery are out of place in a sick-room. One of the secrets of enduring the strain of long continued nursing consists in the use of a daily bath. This will be found extremely refreshing and can be accomplished with a basin and towel in the following manner. Wring out a rough cloth in soap and water, and rub yourself briskly from head to foot ; five minutes each day will suffice to keep you healthy and fresh. You should endeavour to anticipate your patient's wants ; never question in regard to them ; and you will promote your patient's peace of mind very much by moving about quietly, avoiding all hurry, never asking your patient for a decision, and avoiding letting him be startled. Now there are various little things which are apt to disturb a patient. For example, whispering in the room, for it is impossible but that the

patient's attention should be strained to hear. Walking on tiptoe, and stealthily moving about the room are to be avoided. A low distinct tone and a light step will seldom annoy. If your patient is delirious, never contradict him, and humour his notions quietly.

Beyond what I have just said, no advice can be more important to you than the avoidance of all forms of alcoholic stimulants while you are engaged in nursing. There can be no question that long physical fatigue and anxious watching are better maintained on tea, coffee or cocoa than by the use of any form of alcohol or malt liquor whatever.

I am not here to advocate the claims of total abstinence generally, but I do most unhesitatingly affirm that she who would nurse the sick aright with a due regard to the patient's wants and her own comfort, and in order to perform her duty thoroughly, must, for the time being at least, become a total abstainer from alcoholic drinks.

Let me now draw your attention to the patient's bed. Some unfortunates from the beginning of their illness to the time when they are able to get up again, never have their bed made. There can be no greater mistake; the bed should be made at least once a day. If you have, for instance, a patient crippled with rheumatism or perfectly helpless from paralysis, it becomes a very difficult thing to make a bed and change the sheets, and yet if you allow him to go on lying in bed, day after day, and week after week, without changing and making the bed, you not only keep back his recovery and cause him much unnecessary suffering, but you run a great risk of giving him bedsores. As a rule, however ill the sick person may be, his bed should be made at least once a day, unless the doctor absolutely forbids it, as in some special cases he may do.

Remember this is a tiring operation to weak persons, therefore you must choose a time of day when your patient is freshest and strongest. The morning therefore is the best time, when he has had his sleep out, been washed, and had a cup of tea. You should give him a little nourishment before commencing. If possible, do

not have a feather bed, a hair or straw bed is far more comfortable for the patient. A most clean and comfortable bed is a canvas cover or bag, the size of the bedstead, not too full of fresh straw loosely put in; one side left open and tied together with strings. When you make the bed, untie the strings, get a neighbour to raise up the patient, by putting both arms under him and gently raising him off the mattress. Then plunge both your arms into the straw, and shake it up. Then tie it up again. When the bed gets soiled, the straw can be changed. This makes a clean, comfortable, and cheap bed.

I will now tell you how to make a bed. When you cannot take the patient out of it, get a neighbour to help you; do not attempt, if it can be avoided, to do it alone. You want to save the patient's strength, not to exhaust it by letting him try to help you. Now take off all the heavy top clothes, always excepting the top sheet, and remove the pillow, then while one nurse gently turns the patient on his side, the other rolls up the soiled foot-sheet against the patient's back. Now before putting on the clean sheet, untie the strings of the mattress, put in your arms and thoroughly shake up and pull about the straw, tie it up again, roll up the clean sheet, and place the clean roll against the soiled one; now turn the patient gently on to the clean side of the bed, then draw away the soiled sheet, and before spreading the clean one, untie the mattress tapes, and repeat the operation of shaking the straw on this side. Now retie the tapes, spread out the clean sheet and replace the pillow. Now take another sheet, and fold it so above a sheet of macintosh, roll it up, and while one nurse gently raises the patient the other passes this sheet and macintosh below him. This sheet may be easily and quickly changed when necessary without exhaustion to the patient. How to change the top sheet, spread your clean sheet *over* the soiled one, and with the right hand draw down the soiled one while holding the clean one in position with the left. Now replace the blankets and coverlid, and the bed is finished. If the patient is very weak give him a little beef-tea just before or during the process of bedmaking.

Any part that is subject to long pressure is apt to inflame, suppurate, and if not carefully attended to, form a sore—what is commonly known as a bedsore. The parts which are specially liable to bedsores are the prominent bone at the base of the back; also the hips, heels, elbows, and shoulder-blades—indeed, any part where the bone is prominent and thinly covered.

Old weakly people and those who are paralysed require the utmost care to prevent bedsores. If you attend carefully to the following rules, it is very unlikely that these will occur:—

1. Keep the sheet below the patient perfectly smooth—no creases or folds, and no crumbs—and let them be perfectly clean and dry.

2. Wash the parts daily with soap and warm water, dry them well, rub them over with a little spirits of wine or whisky to harden the skin.

3. Change the patient's position frequently.

4. Never let him lie on a blanket.

The first symptom of bedsore is noticed by the skin getting red and the patient complaining of a pricking feeling as if he were lying on crumbs. If the skin breaks, then paint the part over with a mixture of castor oil and collodion (do not use collodion alone). But remember prevention is best. Attend to keeping the undersheets smooth and dry, and if possible get a water pillow.

I show you two kinds, square and circular, they must be filled with warm water, and not be filled too full. Over the water pillow and under the sheet lay a folded blanket.

Do not be satisfied with only washing your patient's face and hands every day, but sponge him all, over with warm water soap and a little vinegar. This will be found very refreshing, and can be easily done without the least risk of giving cold. There is no occasion for uncovering the patient. Put a blanket over him, and sponge underneath. A freshly made bed, a thorough sponge over with vinegar and water, will often, after a restless, sleepless night, have the good effect of making the patient fall nto a sound sleep. In giving patients suffering from paralysis or

dropsy a hot bottle, be very careful to wrap it in flannel, and see that it is not too hot, as in dropsy the skin is very apt to blister, and in paralysis people have often no feeling in the paralysed parts, and so cannot tell when the bottle is too hot. I have seen severe and dangerous burns caused from ignorance of this. In such cases it is better to warm the feet and legs by wrapping them in a warm blanket, than by applying heat directly to the part. Among the many applications which, by the direction of the doctor, you will often be called on to apply to the sick person, are POULTICES; and once for all, let me say to you, that unless you do make these applications properly, you had much better not make them at all. One seldom sees a poultice properly applied except by a trained nurse. Either they are too large or too small, or they are improperly made, and applied often to the wrong place. For example, a cold, wet, dripping poultice, a pound or two in weight, laid on the chest of a poor unfortunate weak creature, panting and gasping for breath, is much more likely to do harm than good; and on the other hand, such a remedy made and applied properly is sure to give instant, and possibly lasting, relief. A good poultice is a very common and a most useful remedy, and every one of you should learn to make it in the very best possible way.

To make a linseed poultice, you require linseed meal, boiling water, and a piece of thick brown paper or calico, a piece of mackintosh, or cotton wool, a flannel bandage, a bowl and spatula, such as I now show you, or a knife. If you are only to poultice the chest, cut your paper or calico like this . . . . . if a jacket poultice for inflammation of the lungs, then cut it in this way . . . . .

Now, to make the poultice, First be sure the water is quite boiling, then scald the basin to make it perfectly hot; now pour in a sufficient quantity of water to make the poultice, then put in the linseed meal, stirring during the process with a spatula or knife until it is of a proper thickness. Now, turn it out on the cloth, and spread quickly, dipping the spatula now and then in hot water while doing so, to prevent the poultice sticking to the knife. Turn over the edges of the calico on the poultice, and apply

it. Then put the mackintosh or cotton wool on the top, to keep it hot, and fasten it on with the flannel bandage. If you have no linseed meal, you can use either oatmeal or bran; if oatmeal, then boil it with the water like porridge. "A poultice should be larger than appears absolutely necessary. It is intended to allay pain and inflammation, and as the pain probably extends beyond the inflamed part, a large poultice should be made to cover the inflamed part."

The poultice should be applied as warm as can be borne, and it should never be allowed to slip or move about. Unquestionably, linseed meal is the best material for an ordinary poultice. Care should be taken to renew the poultice before it becomes cold.

A mustard poultice can be made in various ways. One way is to make a linseed poultice, and sprinkle a little mustard on the top. This is the best way, if the patient is a child. Over the surface of the poultice next the skin, put a piece of thin muslin. If a stronger poultice than this is required, it may be made by mixing two or three spoonfuls of mustard along with the linseed meal, or stronger still, mix a sufficient quantity of mustard with tepid or cold water to the consistence of a paste, according to the size of poultice you wish, and spread it on a piece of brown paper or rag, and over the surface. You may keep a mustard poultice on the patient fifteen, twenty, or thirty minutes; some skins are more sensitive than others, and when the part is red it is time to take the poultice off. Then sponge the skin quickly with tepid water, and lay a piece of cotton wool over the part.

Fomentations. To lessen inflammation and relieve pain, hot fomentations are often required, and are an excellent remedy; but remember what I have just said about the poultice applies equally to the fomentation. A cold dripping wet flannel will only add to the patient's misery and discomfort, while a thoroughly dry hot flannel is almost certain to give him great, immediate and lasting relief. Now let me explain to you then how a fomentation is to be made and applied. You want first of all boiling water, a piece of mackintosh or cotton wool, and a

large piece of coarse flannel, the coarser the better as it retains the heat longer, (a piece of old blanket or scouring flannel makes the best fomentation), a towel, and a basin. Now lay the towel over the basin in the way I show you, fold up the flannel and lay it on the towel. Now see that the water is boiling and pour it over the flannel. Then wring it in the towel as dry as you possibly can. Cover over with the mackintosh or cotton wool, and fasten it on with a flannel bandage. If you want to apply dry heat, heat salt, sand, or bran over the fire or in the oven, put it in a flannel bag and it will retain the heat for a long time. Hot bricks wrapped in flannel are very useful.

You are frequently enough required to apply cold to the head. To do so take one fold of cotton or linen rag, soak it in cold water, the colder the better, squeeze dry and apply it as rapidly as possible. Do not take a large piece of cloth folded several times, and keep squeezing it in your hand till it is quite hot and then put on. One fold of cloth, the thinner the better, dipped often in the cold water and rapidly applied gives great relief in headaches, for example.

If you can procure ice put a piece in the water. Ice is sometimes ordered to be kept constantly on the head; to keep it from melting, wrap it up in flannel, or put it in sawdust, and in a cool place. To break ice, do it in this way with a needle. Ice-bags can be bought for three or four shillings, or it may be put in a bladder and applied to the part, or a bag may be made of gutta percha and chloroform. By putting a little chloroform along the edges and folding them over, you can make a very useful bag for ice; the ice should be broken in small pieces before being put in the bag, and be removed as soon as it melts.

Nourishment is the third great factor of life, and food plays a most important part in the treatment of all illnesses, more especially fevers. The nurse must devote much of her attention to the subject of diet. You must observe carefully your patient's appetite, and attend carefully to the quantity of food and the effects of it. Give the nourishment regularly and at short intervals if the patient cannot take much at a time. Let me

beg you to be scrupulously clean with everything you prepare for the patient. If the doctor orders the patient a milk diet, your duty is to see that the patient gets that and nothing else. Be careful in this, as in all other instructions you get from the physician, to keep to it carefully. Milk is the most valuable article of diet in the sick-room. I may here remind you that about half-a-pint of milk is equal to about a quarter pound of beef in nutritive value. You must endeavour to get the milk good and to keep it sweet by keeping it in a cool place, and what is equally important, in a perfectly clean jug or basin. If you cannot manage to keep the milk sweet, then boil it at once when you get it and use it cold. Should the patient have sickness or diarrhœa, add one or two tablespoonsful of lime water to each tumblerful of milk. For any one very ill, and not able to sit up, use always a feeding-cup, such as I now show you. In feeding the patient with this cup, put your hand under the pillow and raise the pillow and the patient's head together, and take care you do it straight, so that the milk goes into his mouth and not down his neck, as is too often the case with careless nurses. The drinking-cup must be carefully cleaned by pulling a feather down the mouthpiece, and, when the vessel is not in use, it ought to be kept in clean cold water. Beef tea is not of so much intrinsic value as milk, but is useful as a stimulant as well. To make very strong essence of beef, you should do as follows :—You require a quarter of a pound of lean beef, take off all the fat, mince the beef very small, put it into a jar or pig covered with a lid or paper, place this in a pan of *boiling* water, the water to come half way up the jar ; boil for five or six hours, then pour off the beef tea, and give one teaspoonful or a half at a time. Ordinary good beef tea, such as you will now see made, is made by taking one pound of beef cut from the round, cut it into very small pieces, taking off all the fat, put it into a pan with a little salt and add a pint of cold water; put it on the fire, and when it comes to boil stir till it is well mixed—say five minutes; then draw the pan to the side, and let it simmer for ten or twenty minutes, and it will be ready for use.

Egg Flip.—An excellent, quickly made, and most nourishing drink for invalids is to beat up an egg with a little sugar and boiling milk or water, stirring all the time.

If it can be at all managed, don't cook your patient's food in the sick room. He will be much more likely to take and enjoy it if he is not fussed seeing the process of cooking.

Medicine.—In giving sick people medicine there are three points you ought carefully to remember. 1, *Regularity;* 2, *Punctuality;* 3, *Exactitude.*

1. Give the medicine ordered by the doctor regularly, not sometimes one dose in the day and sometimes three, but just as often as you are told, and no oftener, every three hours or every four as the case may be.

2. Then be punctual; give it at the same time every day, ten o'clock, twelve o'clock, just as ordered.

3. Exactitude is a most important point. Always give the right medicine and the right dose. It has happened that people have been poisoned by getting either the wrong medicine or an overdose of the right.

Never allow a bottle of lotion for external use to stand beside a bottle of medicine to be taken internally. Keep them entirely separate, and let me beg your attention to this piece of advice,—keep all medicines in a place where children cannot by any possibility reach them. One further piece of advice, which is unfortunately but seldom attended to, is deserving of your attention, namely, after an illness has terminated either in recovery or death, empty out all the medicine bottles, and on no account retain any of them for future use. Spoons differ very much in size, and it is not wise to trust to them in measuring medicines. It is best to get a medicine glass or spoon, either of which can be got at a chemist's for a few pence.

To those of you who are entrusted with the administration of medicine to sick persons, the following hint will, I am sure, prove invaluable, namely, always read the label on the bottle before administering the medicine. By doing so you may probably save yourself from a lifelong reproach.

I now desire to address to you a few words on the nursing of children.

To nurse a sick child is a more difficult task than to nurse a grown-up person, who can tell you exactly how he feels and where his pains and aches are. Young children are utterly dependent on the kindness or cruelty of those about them, and very many suffer all their lives from the effects of the carelessness and ignorance of mothers and relatives. Frequently the only indication of a child being ill is its fretfulness. If the child is usually happy and good-tempered, and suddenly becomes cross and fretful, then you may be quite sure he is ill, and instead of scolding him, as is unfortunately too frequently the case, you ought to set yourselves to try and find out what is the matter. Many children want nothing but fresh air, proper food, warmth, and cleanliness, to enable them to grow up strong and healthy; and the want of one or other of these, is often the sole cause of illness. Children suffer from the same causes as grown up people, but much more quickly and seriously; nothing does them more harm than bad air. This is specially so at night; nothing can be worse than putting them to sleep in a close shut up room. Take care that you give them plenty of fresh air, and at the same time plenty of warmth. The disease which you all know as "rickets," and which is unfortunately very common amongst the poorer classes of our large cities, is mainly brought about by a want of pure air and light, as well as, no doubt, by insufficient food. Now, the two first of these requisites cost nothing, perhaps only some trouble and thought; and because these are not attended to our hospitals and dispensaries are crowded with children stunted in growth, with deformed chests, crooked backs and legs, and altogether in a miserable condition.

It is worth while to draw your attention to the first signs of this disease known as "rickets." Amongst the earliest indications of it is that the child perspires at night chiefly about the head, then the whole body seems to be tender and sore. He cries when touched or put down to walk. When you notice this, do not on any account let the child walk, give him as much fresh

air as possible, as much sun and light as you can (if possible, it is as well to take him to the country), clothe him warmly, and give as much good nourishing food as you can; three pints of milk daily if possible, and take your child to a hospital for advice. Unless taken in time, remedies are no use at all, and if neglected, he is sure to grow up ill-nourished and deformed.

There are some diseases of children, which come on so quickly that remedies come too late, and much valuable time is lost, if you wait till a doctor can be got. Croup is one of these; and as it most frequently comes on at night, it is of the utmost importance that you should know what to do at once, while waiting for the doctor to come. The first symptoms of croup are, that the child seems hot, fretful, and cries hoarsely. Young children are not often hoarse, unless they are in danger of having croup. The next sign is a peculiar ringing cough—the breathing becomes more and more laboured. When such is the case you should at once send for a doctor; but without waiting for his arrival put the child in a hot bath. Try to do this without alarming him, or making him scream, which will do harm. Lay a blanket over the bath or tub, on this blanket place the child, and let him gently down into the water. Do not burn him with too hot water, but carefully test the heat, not with your hand, which can bear much more than the child's tender skin, but the back of your hand or elbow.

After the bath, wrap him in a blanket, and take care he does not get a chill. Then give the child an emetic—one tea-spoonful of ipecacuanha wine every ten minutes until he vomits. Wring a sponge or flannel out of very hot water and place it to his throat, renewing it as soon as it cools—this is, let me tell you, a simple but effective remedy. When the attack of croup is severe, you may be ordered to keep the child in an atmosphere of steam. You can do this by making a tent over the bed with clothes-screens and a sheet or coverlet stretched over it.

Put a basin on each side of the bed, under the tent, and keep them constantly full of boiling water, emptying and refilling them alternately every quarter of an hour. Another method is

to keep a kettle constantly boiling on the fire. Bring the bed and tent near it; fix one end of a long india-rubber tube on the spout of the kettle, and bring the other end near the bed under the tent; the room ought to be kept well ventilated and moderately warm; you should feed the child on milk and beef-tea, and avoid giving him any solid food.

My time will not permit me to say more in regard to children at present, but before leaving the subject I should like to draw your attention to two things. First,—In a case where a child is seized with a fit, you should at once place him in a warm bath, as I have already described to you; give him a dose of purgative medicine such as castor-oil, and apply cold to the head. And in the second place, let me warn you against the use of soothing medicines and teething powders, which are too commonly given to young children. Nothing but harm can result from the use of such remedies. No sleeping draughts, nor any form of soothing syrups should ever be administered to a child except by the *direct* advice of a doctor.

Infectious Diseases.

Fevers are spoken of as "catching," infectious diseases, and about those you ought to know; not only how to nurse the person, but how to prevent others from catching it too. Scarlet fever, for instance, is highly infectious. The usual time for incubation is from twenty-four hours to three days; the rash is seen first on face, arms, and chest, like little red dots at first, and then becoming a red blush all over. It remains for three days, and gradually fades away. As soon as it disappears desquamation commences, that is, the skin begins to peel off. This is sometimes over in five days, and sometimes not for four or five weeks. In some cases the throat is much affected, and the child may be delirious for two or three days, or it may be very slight, a little, sick, slight sore throat, a little red blush, scarcely visible over the skin at night; the next morning, apparently, the child is all right; you think nothing of it, and he runs about as usual. When this is the case, and desquamation begins, you may notice

the child's eyelids swollen, and his face look puffy, breathing quick, the child seems very ill indeed, and if you do not at once send for a doctor, and use the proper means, he will most likely die. Many children die from this cause, getting cold during the stage of desquamation ; while the peeling process is going on, the greatest care from cold requires to be taken to prevent the kidneys becoming affected on account of the deficient action of the skin, and dropsy following. If you should then notice the child's face puffy, and eyelids swollen, at once give him a hot bath, wrap him in blankets, put him in a warm bed with hot bottles, give him a hot drink, and try to get him to perspire freely ; but while doing all this, send for a doctor, and be very careful to guard against draughts, a chill would be most dangerous.

A quick way of getting the patient to perspire is to use a vapour bath, such as the one you see here. Wrap the patient in a blanket ; place an iron cage, stool or something that will keep up the bed-clothes and allow the hot steam to get to the patient over the foot of the bed ; place the bath at the foot of the bed, with the tube passing into it ; fill the boiler of the bath with boiling water ; light the lamp and place it underneath. In ten or fifteen minutes you will probably find the patient perspiring freely ; when this is the case remove the bath, and keep him very warm.

Infection in scarlet fever is conveyed by the flakes of skin shed when desquamating ; those may be carried long distances, and be conveyed from one person to another by means of letters, books, clothes, &c. To nurse the patient with as little risk of infection to others in the house as possible, put him in a room by himself, at the top of the house, if possible. Take all unnecessary furniture out of the room ; remove carpets, window curtains, and bed curtains. Hang a sheet steeped in carbolic acid, one to twenty parts water, over the door, and keep it always moist ; before taking clothes, bed linen, &c., from the room ; put them into a pail or tub full of *boiling* water, or water and carbolic acid one to twenty or forty, for half an hour. Sanitas or chloralum may be used instead of the carbolic. When desquamating, if you rub the

patient all over twice daily with camphorated oil, it will help greatly to prevent infection spreading. When the patient is convalescent give him warm baths with Condy's fluid, and wash with carbolic soap. When sweeping the room, burn the dust carefully, do not carry it out of the room. When nursing the patient, wear a washing dress, change it, and wash your hands in Condy's fluid and water, or some other disinfecting fluid before leaving the sick room. What has already been said about ventilation applies to fever patients, and rooms quite as much as any other sick room. Cleanliness and fresh air are the best disinfectants.

To disinfect your room after the patient has left it is a very simple matter. Close every window and door; put some red cinders on a shovel, place this over a pail or iron-stand in the centre of the room, and over the cinders sprinkle 1lb. or so of powdered sulphur; let the room be kept closely shut up for six hours, then open doors and windows to air thoroughly. You may disinfect letters, clothes, etc., in the same way, by hanging them up in the sulphur fumes. It is always the safest plan to burn books and papers used by a scarlet fever patient.

Measles usually begins like a common cold; the rash appears on the fourth day or later, little round red spots running into patches. Keep the patient in a warm room and in bed until quite convalescent, guarding against draughts, as in measles there is danger of the lungs becoming affected, and if this happens the case becomes very serious. The diet should be very light, plenty of good milk, beef-tea, etc., until quite convalescent, then a little fish is always a good thing to begin with.

Typhoid Fever has several names—Enteric, Gastric, etc. When you have this fever in your house, you must suspect something wrong either with the drainage, water, milk, or it may be from the dirty, badly-ventilated state of your whole house. You should not rest satisfied until you find out the cause. It is a fever that comes on very gradually, the patient can scarcely tell when he first began to feel ill. A chilly feeling, headache, pains in back and limbs, loss of appetite, sickness and diarrhœa are the usual symptoms. The patient does not

often take to bed until the second week. The fever usually lasts from three to four weeks and then he should begin to mend. The feverishness gradually disappears. At this time the very greatest care and attention are required or a relapse will follow. No fever requires such watchfulness and care on the part of the nurse as to diet. The doctor's orders as to this must be rigidly carried out; a very slight indiscretion, such as eating hard biscuit, grapes, etc., has been known to cause perforation of the bowels and death. The usual diet is milk, three to four pints, given a tea-cupful at a time. Until allowed by the doctor give nothing but milk and do not allow the patient to leave his bed.

Infection is conveyed by the effluvia and emanations from the intestinal discharges of the patient. Those should be at once covered and got rid of, using disinfectants freely, carbolic powder or chloride of lime is best. Strict cleanliness of all utensils used for the patient should be observed, and for her own safety, the nurse must be careful not to inhale the effluvia from the motions of the patient. If strict cleanliness, good ventilation and a free use of disinfectants is observed, there is little danger of infection from typhoid fever.

Typhus Fever is caused by overcrowding, bad ventilation, a dirty condition of houses, clothes and people. It is a preventible disease. It comes on more suddenly and is more quickly over than typhoid, usually lasting fourteen to seventeen days. Relapses are not usual. Commonly it sets in suddenly with a shivering fit, headache, a feeling of languor and drowsiness, the skin hot and dry; as the fever goes on the patient lies in a stupor, quite indifferent to what is going on. The nurse must not only think, but act for him; he does not ask for nourishment, and can scarcely be induced to take it; his life depends on the nourishment being given regularly. Towards the end of the first week a rash appears—small, dull, crimson, irregular spots, chiefly on the back and arms; the teeth and lips become covered with a brown crust called "Sordes." This must be cleaned with a piece of lemon, or rag dipped in lime-juice, rubbed over them. The lips and tongue often become cracked and very painful, and bleed occasionally; when this is the case rub a little vaseline ointment

over them after cleaning off the sordes. *Bed sores* in all fevers must be carefully looked for, and the precautions I have already told you of, used.

The bed linen of fever patients should be changed very frequently; always provide the bed with a mackintosh and draw-sheet. If the head is not ordered to be shaved, always cut the hair quite close; it is best to do this, as the hair will come out afterwards. Frequent sponging of the body with tepid water and vinegar is very refreshing, taking care there is no exposure to cold. I have already stated how this may be done. On the careful nursing of fever patients, and extreme regularity in administering nourishment, depends in great measure the patient's life.

In the early stage of convalescence there is always a danger of the patient sinking from weakness and exhaustion; notice particularly any tendency to chill, and this specially in the early morning. Cover the patient with a well-warmed blanket, put a hot bottle in the bed, and give him a warm drink. When very weak the patient must be roused to take nourishment. If you neglect to do this, or think it a pity to disturb him, he may pass into a state of fatal collapse.

In typhus fever there is a peculiar odour from the patient's breath and skin, and it is by this that the contagion is conveyed; plenty of fresh air, strict regard to cleanliness, and sponging the patient all over frequently with warm water and carbolic lotion, or Condy's fluid. Attention to these points is the best safety against infection spreading. No one should ever go near a fever patient fasting.

About the fourteenth day the crisis may come very suddenly. Perhaps at night the patient may be very delirious and feverish; towards morning he may fall asleep, and wake quite conscious, less feverish, skin moist, and a healthy expression returning to his face. During the early stage of convalescence he sleeps a great deal. The same precautions with regard to disinfecting room, clothes, patient, etc., that I have already told you of in speaking of scarlet fever, applies to *all* infectious or "catching" diseases.

SANITARY LAW AND ADMINISTRATION.

By WILLIAM C. SMITH, LL.B., Advocate.

THE sanitary law of Scotland comes from two sources,—first, what lawyers call the common law of nuisance: and second, a long series of statutes, all of them passed within the present century, some of which apply to the United Kingdom, and others to Scotland only. If I confine myself to-night to a consideration of these statutes, it is not because the common law is either antiquated or inefficient. It is a severe and stringent law, and it has quite recently been put in force. Only the other year a large manufactory of artificial manures near Inverness was stopped by order of the Court of Session, because the fumes of the sulphuric acid used in dissolving bones found their way into the adjoining mansion-house of Bunchrew and made some of the inmates sick. Still more recently, you may remember, the Shotts' Iron Company were interdicted from burning ironstone at their works near Penicuik, because the sulphurous smoke was injuring the plantations upon the estate of Glencorse. Now, in both these cases, the manufacturers had made considerable efforts to obviate the nuisance. They had erected new buildings and had used extraordinary precautions in the conduct of their business. To stop the works meant enormous loss or ruin. But the law of Scotland says:—"No one is entitled so to use his property as to cause injury to his neighbour's property, or to the health of his neighbour, or to render the occupation of his neighbour's property positively uncomfortable." And so these works were closed.

But the common law, if properly enforced, gives us not only pure air but pure water. You must have read in the newspapers how vigorously during the last few years the landed proprietors of Scotland have asserted their rights against the rapidly increasing pollution of rivers. The Esk, the Almond, the Whiteadder, have all been rescued from absolute destruction, and there is some ground for hoping that Gala Water may again become the pure and beautiful stream which inspired the noble song of Burns. Sometimes it is a paper mill, which is doing the mischief, sometimes a shale mine, sometimes a system of town drainage. The mill owners say, "how can we manufacture without a supply of water?" and the town's people say, "how can we live without drains?" The answer of the law of Scotland is that they must solve these difficulties for themselves. It is so stated by one of the greatest of Scottish Judges: "Riparian proprietors are entitled to use the water in any way they like, as it passes through their property, subject only to certain conditions. Now, these conditions are that they shall send down the water to their neighbours below, undiminished in quantity, and unimpaired in quality. It is impossible in the nature of things that a running stream should not receive in its course certain impurities as it passes along. But the meaning of the condition is that no unnecessary or artificial impurity shall be put into the stream, so as thereby to diminish the purity of the water as it passes to the proprietors or the inhabitants below." In fact, according to the theory of the law, all streams should be fit for drinking by man and beast, and for cooking and washing within dwelling houses, unless these primary and natural uses have been destroyed for a period of forty years. I am not going to speculate in what way towns and landed proprietors, and mill owners are to find a *modus vivendi* in the future. In all probability the mill owners will be compelled to store their own water in reservoirs, and towns will dispose of their sewage by one of the many schemes of irrigation. But I have said enough to show that as regards water as well as air, the common law of Scotland is not to be broken with impunity. But my object this evening is to explain

to you the leading principles of sanitary law, not as they affect private rights, and form the subject of disputes between private individuals, but as they have been incorporated into statutes, the administration of which has been committed to certain public bodies. And as it is with administration in Scotland, that we are mainly concerned, I shall say most about statutes which affect Scotland only. Before doing so, however, it is necessary to mention the more important Sanitary Acts which apply to England and Scotland alike.

First and foremost of these is the Factory and Workshop Act of 1878. I wish that time permitted me to sketch the gradual development of the Factory Laws: a movement with which the name of Lord Shaftesbury will for ever be associated. I wish I could point out how it has been found necessary in the public interest to put one trade after another under regulation, until now it is a little difficult to specify any workshop which is not a Factory: how clauses providing for education have been added to clauses providing for the safety of machinery; and how reasonable restrictions on the labour of the young have been added to sanitary provisions. Those sanitary provisions are either general, applying to all factories and workshops, or special, being restricted to certain trades. The general rules are these: (1) That every factory and workshop shall be kept in a cleanly state and free from effluvia arising from any drain or nuisance. (2) That there shall be no overcrowding injurious to health. (3) That the shop shall be ventilated so as to make harmless the gases, vapours, dust and other impurities which are generated in the course of the manufacture. The Act itself prescribes what means must be taken to ensure cleanliness. If the inside walls and ceilings, and passages and staircases, have been painted with oil or varnished once in every seven years, then you must wash them with hot water and soap once in every fourteen months: if not painted with oil or varnished, then you must limewash every fourteen months. I daresay a good many of us have been in workshops where the smells were not quite heavenly, and where there seemed to be either too many hands, or too little

ventilation. There is nobody on the spot to see that the Act is carried out: there is a limited staff of inspectors; and it is only now and then that the inspector can overtake each factory. And when he does come, he cannot see everything, and the proper complaints are not always made. I believe the number of inspectors ought to be considerably increased, but to whatever extent you multiply inspectors, it will always be the case that the Factory Act will not be fully carried out, unless the inspector is supported by an intelligent opinion among the workpeople themselves, and by a resolution to help in the inspection. If from a fear of offending the authorities, you won't speak out, you can't expect that what is wrong will be set right. On this subject I should like to mention the 68th section of the Act, which provides that anyone who attempts to prevent a child, a young person or a woman, from appearing before the inspector, is held to have committed an offence against the Act, and to be liable in a penalty of £5; and I should add, what is not so generally known, that under the 4th section of the Act the inspector is not merely entitled to point out any contravention of the Factory Act, but if he sees anything wrong—say with the supply of water—under the Public Health Act—he is bound to give notice of that to the local authority of the town or parish. I cannot leave these general rules without reminding you that a very serious liability is incurred by sending or admitting to employment a child or young person who is not fit for work. Wherever the age is less than sixteen, there must be a certificate after personal examination by a surgeon that he is satisfied with the evidence of age shown to him, and that the child is not incapacitated by disease or bodily infirmity for working daily for the number of hours allowed by law. That regulation may often seem a harsh one, when there are many mouths to feed at home and every shilling that comes in is counted. But I believe it to be just and necessary. Many children have been killed by attempting work beyond their powers. The infirm or diseased child may find some lighter work: if not, the parents must submit to the burden which they have placed upon themselves.

Among the regulations of special trades I can mention only two. There are certain shops, in which grinding, glazing or polishing is done upon a wheel, and dust is given off which is inhaled by the workers to an injurious extent. In such cases the inspector has power to order the use of a fan, or some other mechanical means to prevent the inhalation. Again, you know, that bakehouses have to begin work very early in the morning. I think I have seen their chimneys beginning to smoke between 4 and 5 A.M. That has led to a practice of bakers sleeping near the bakehouse. Now it is a contravention of the Factory Act to sleep in a room on the same level with the bakehouse, unless the room is effectually separated from the bakehouse by a partition from floor to ceiling, and unless there is an external glazed window of at least 9 superficial feet, of which $4\frac{1}{2}$ are made to open for ventilation.

There is one great class of industries, upon which the prosperity of the United Kingdom depends to a very large extent, and to which the Factory Acts do not apply. I mean the mining industries. Their development of late years has been very rapid. Take coal alone. In Scotland between the years 1871 and 1875 the annual output of coal rose from 15,438,000 to 18,597,000 tons, and 146 new collieries were opened. I do not say that all that increase was legitimate and healthy. In fact, a good deal of the enterprise of that period was carried on in the spirit of the gentleman who said, in 1873, that if he did not find coals, he would go on sinking to a place remarkable for its warm climate, and bring up cinders. But the coal trade lies at the very foundation of our manufacturing and commercial greatness, and therefore for the most selfish reasons, apart from motives of humanity, we are interested in the sanitary condition of our coal mines. Now that matter is at present regulated by two comprehensive Statutes: The Coal Mines Regulation Act of 1872, which applies, not only to coal, but to stratified ironstone, shale, and fire-clay; and The Metalliferous Mines Regulation Acts of 1872 and 1875, which apply to all other mines. Now, the grand principle of both these Acts is that neither women nor

children may work under ground, and that the employment of young lads is put under wholesome regulation. I think that may be truly described as a piece of sanitary law; for if children are to be stunted by premature exertion, and mothers are to wear themselves out by labour outside their homes, I don't see how you can expect either health or happiness in this world. But in the narrower sense of the term sanitary law has to do only with physical agents, and in this sense the most valuable provision of The Coal Mines Act is this, that no mine is to be worked unless every seam has two shafts or outlets in communication with it, with ten feet of natural strata between these shafts, and between them also a road four feet wide and three feet high; and unless there is at the mine ready and available for use some proper apparatus for raising and lowering workmen. But the law does not stop there. The main purpose of these shafts, as was shown by Prof. Maclagan in a simple experiment at the beginning of his course, is to produce ventilation. According to the General Rules made and published under the Act, in every mine an adequate amount of ventilation must be constantly produced, so as to dilute and render harmless all noxious gases in the working places and the travelling roads. And it is the law that every twelve or twenty-four hours, before any shift of workmen begin their work, some competent person appointed by the owner shall inspect that part of the mine with a safety-lamp, and make a true report on its condition. And under the same Rules the miners themselves have a most important power, for once a month they are entitled to appoint two of their own number to make a thorough inspection of the mine. Now, all that makes a great charter of safety and protection to the workmen, and yet you know how many sudden and terrible calamities occur at our mines, how many heart-rending scenes, how great an annual loss of life. Who does not know the desolation of that scene at the pit-mouth, with shattered buildings and wrecked machinery, and round about the crowd of weeping, silent, pale-faced women? In this, as in every other case, a good law must be well administered in order to succeed. Now, the Government Inspectors of Mines are men of

energy and devotion, but they have no time to make a sufficient number of inspections. In these circumstances one would expect that the men themselves, who have the strongest interest in the matter, would do something for their own protection. Alas ! we know that the very opposite is the case, and that many of these dreadful accidents are caused by the reckless negligence of the men themselves.

I think that, besides factories and mines, there is only one other large class of works which have been placed under systematic regulation. These are the alkali works—works for the manufacture of alkali, sulphate of soda, or sulphate of potash. The muriatic acid gas which is evolved in such manufactures is one of the most disagreeable and dangerous of the nuisances of trade. You all know what volumes of poison some of these tall chimneys used to pour into the surrounding atmosphere. For the last twenty years the alkali manufacturers have been directed under penalties to condense their gas. By the Alkali Works Regulation Act of 1881 the law has been extended to sulphuric and nitric acid works, chemical manure works, gas liquor works, sulphate and muriate of ammonia works, and chlorine works, where bleaching powder or liquor is made. You will not be surprised to hear that the law deals sharply with these trades. The muriatic acid gas must be so condensed that each cubic foot of air, smoke, or gas escaping from the works does not contain more than one-fifth of a grain of muriatic acid; and the acid gases of sulphur and nitrogen must be so condensed that the total acidity per cubic foot does not exceed what is equivalent to four grains of sulphuric anhydride, all these proportions being ascertained at a temperature of 30 degs. Fahr. and a barometric pressure of 30 inches. The owner of the work would apparently have to go through a difficult chemical investigation to know whether or not he is keeping the law; but if he does break it, he is liable in a fine of £50 for the first offence, and £100 for the second. So far then as the law can secure it by inspectors coming down from London, the air round these chemical works will be rendered pure. But this Act further provides for the inspection

of (1) salt works, where the extraction of salt from brine is carried on, and (2) cement works, in which albuminous deposits are treated for the purpose of making cement. In these cases no precise standard of purity is laid down, but the owners are bound to use the best means which can be adopted at a reasonable expense for preventing the discharge of noxious or offensive gases or for making such gases harmless when discharged.

There is one other class of public buildings in the sanitary condition of which most of you must take a very warm interest: I mean the public schools. In these schools your children spend a great part of their lives at a time when the physical as well as the mental character is being formed. Do you imagine it is a small thing whether that time is spent under healthy or unhealthy conditions? Now, on this important matter the Education Act itself makes no express provision. But the object is accomplished indirectly. You know that the great majority of these schools have been built by the help of building grants from Government. According to the Education Code for Scotland, no building grant was ever made except for a site which was healthy and free from noise, and consisted of at least 1200 square yards. So much for construction, but that does not go very far. You also know that the great majority of these schools are to a large extent supported by annual grants from Government, which are given upon certain conditions of proficiency. Now, it is a leading condition of all these annual grants that the school premises must be well lighted, cleaned, warmed, drained, and ventilated, and properly furnished; that they must be supplied with suitable offices, and must contain sufficient accommodation for the average attendance of scholars—that is to say, 80 cubic feet of internal space and 8 square feet of area for every child. I have no doubt these regulations are generally observed, but it is one thing to have regulations and another thing to have them duly carried out. Her Majesty's inspectors are no doubt bound to report cases of defective ventilation and overcrowding. But their time and attention are very much occupied with the examination of the children, and I think it is the clear duty of parents to satisfy themselves that the health

of their children is receiving at school that protection which the law affords. Whether or not the regulations I have mentioned are sufficient in themselves I must leave the doctors to determine. But I know one fact which makes me greatly doubt their sufficiency. Five years ago there was an alarm about schoolroom poisoning in New York. The Medico-Legal Society of that city appointed a committee to confer with the school authorities upon that subject; and in the report of that committee I find it stated that five hours' daily school session requires 150 cubic feet as the smallest space compatible with efficient ventilation without dangerous exposure to draughts. So that in New York they think necessary for health almost double the amount of space which is mentioned in the Education Code.

Edinburgh is neither a manufacturing city nor a trading port; but we have all some friends upon the sea, and I think it may interest you to know that the sanitary law is not confined in its operations to the dry land, but extends a paternal care over our sailors on the mercantile marine. The main provisions on that subject are contained in "The Merchant Shipping Act of 1867." It is obvious that sailors on a voyage are very much at the mercy of the master. They cannot change their employment, they cannot even shift their lodgings. Lately we have had painful statements of the barbarities practised on apprentices. Accordingly the law has said that every place in a ship occupied by seamen or apprentices shall have a space of 72 cubic feet and 12 superficial feet for each seaman or apprentice, and the words "certified to accommodate ——" so many must be painted up over the door or hatchway. Further, the place must be securely constructed, properly lighted and ventilated, properly protected from weather and sea and from the distressing effluvia which are often caused by cargo or bilge water. But Jack Tar is not only entitled to a comfortable berth, he is also entitled to good food; and if either provisions or water are of bad quality and unfit for use, or even deficient in quantity, the master will be punished and the seaman will get compensation. The law even goes the length of making minute regulations on the subject of Jack's grog. Every

ship must carry a sufficient quantity of lime or lemon-juice as an anti-scorbutic, containing fifteen per cent. of proper or palatable proof spirits. Proper and palatable spirits are defined by Statute to be sound rum of a specific gravity from ·074 to ·920 or sound brandy of a specific gravity not less than ·920. I do not know what our teetotal friends will say to that. It is difficult for the human mind to imagine a British sailor who does not drink rum. Whether it is necessary or even beneficial I am quite unable to say. I saw the other day a statement by Lord Wolseley that for a long time back he had constantly discouraged the drinking of spirits in the army. Sailors, no doubt, stand in a different position and are exposed to other influences; and I suppose a man may take his anti-scorbutic "cold without" rum if he prefers. It is amusing, however, to observe that the Board of Trade actually take the trouble of mixing the grog for the seamen. They recommend that one ounce of the lime juice should be mixed with one ounce of sugar and at least half-a-pint of water and should be served out in time for dinner.

The consideration of lime-juice grog leads one naturally to the law relating to adulteration. If any of you have looked at the volumes of *Punch* about 1850 you must have been amused by the very lively description which is given there of the great adulteration scare. A report had just been published by the Lancet Analytical Sanitary Commission, which disclosed the existence on a large scale of systematic adulteration, and *Punch* represents Mr Briggs, the British paterfamilias, as using an enormous microscope at the breakfast table, and gradually discovering, to his horror; that the sugar, the coffee, the bread, the mustard—everything was composed of deadly poisons in various combinations, and that the water was swarming with animalculæ which, to his excited fancy, assumed the most repulsive forms. Mr Briggs looked forward to the immediate starvation of himself and family, but this calamity was averted by the passing of an Act in 1860. That Act imposed a penalty on every person who knowingly sold any article of food or drink mixed with any material or ingredient injurious to health. Some of the worst kinds of

adulteration were suppressed, but the Act broke down when it was applied to the case of mustard. At that time mustard was largely mixed with flour, and it was impossible to prove that flour is injurious to health. Another Act was therefore tried in 1872, but that Act also broke down in a prosecution of some Liverpool trades-people for selling butter mixed with fat, because it was impossible to prove that the tradesman knew that fat had been put into the butter in order to increase its weight and bulk. Accordingly, in 1875, the Sale of Food and Drugs Act was passed, of which the most interesting provision is that, under a penalty of £20, no person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality demanded. The way that Act is worked is this. Every town and county appoints a public analyst, and his duty is for a small fixed fee to analyse any sample which is brought to him by a member of the public. But only in some of the large towns is anybody appointed for the purpose of going round the shops and trying to discover cases of adulteration. Unfortunately, too, the Act is not compulsory, and it has not been much adopted in Scotland. Indeed it has been said that individual analysts, like Mr Cameron in Ireland, and Mr Stoddart in England, do more work in a single year than has been done in the whole of Scotland since 1875. You will therefore see that unless you yourselves take some interest in this matter, you are not likely to derive much benefit from the Act. And your interest is very great. There is no article of food on the purity of which your children's health depends so much as milk, and there is no article of food which is so easily and so much adulterated. I will give you an instance of that. The inhabitants of Dundee are said to spend £50,000 a year on milk. In March 1881 the Police Commissioners of Dundee caused a number of samples to be analysed and a number of milk dealers to be prosecuted. The result was that in the course of a week the value of the milk supplied to Dundee increased 25 per cent.; and it is therefore clear that for want of a public analyst Dundee had been losing £12,500 per annum. I am glad to say that

there is a very considerable improvement in the quality of the milk now sold in Scotland. Dairymen do not now put in chalk, gypsum, starch and animal brains, as they used to do, in order to make up the specific gravity. But they still take away the nourishing qualities of milk by skimming and adding improper quantities of water. One is not surprised to find water in butter-milk, because in cold weather they use hot water to bring up the temperature of the milk, before the churning begins. But the difficulty is to say how much water a dealer is entitled to put into pure milk. In a Glasgow case last year there was 18 per cent. of water according to the Somerset House standard, and the sheriff refused to convict the dealer. In the more famous Paisley case the year before, a man bought 4d. worth of cream, which was found to be diluted with 30 per cent. of skim milk. The dealer said there was a practice in the trade of selling two qualities of cream—one of good cream, at 2d. the Scotch gill, and another at 1d. the gill, which was largely sold to the working classes. In that case, and in another where the cream contained only 11 per cent. instead of the average 25 per cent. in weight of fat, the Court also refused to convict, one of the judges saying, "It is a great matter if the legislature is able to protect the public against unwholesome adulterations, fraudulent imitations, and deceitful disguises of bad quality; not effectually of course, but so far as possible in the existing moral and intellectual condition of dealers and customers in this country. Beyond this it seems desirable in the meantime that the richness of cream should, like the freshness of fish and the tenderness or fatness of beef, be left, as the prices are, to be arranged between buyer and seller." That is Lord Young's opinion; and therefore in the meantime you must look after your own interest in the buying of milk. I think it not improbable, however, that before long the judge will get some authoritative standard to go by from the government chemists. The law has dealt more effectually with butter. The manufacture of artificial butter has now become a great trade. Formerly, the farmer's wife put into the churn a pound or two of candle grease or hog's lard. But now there are

huge establishments at Hamburg and in America which turn out what the trade call "Jersey butter." A conviction was got in a very bad case of this kind, where the butter contained 60 per cent. of extraneous matter. I would rather not tell you what the extraneous matter was: I believe grease and brain matter. But since that case the new butter is sold as Butterine or Margarine.

One word about whisky. Some people will tell you, drink no whisky, you have yourself to blame if you get it bad. Perhaps you remember a story of the late Dean Ramsay's of a Highland drunkard, on whom the minister was trying to impress the fact that whisky was a very bad thing. "Aye, aye," said Donald, "it's a bad thing whisky, specially bad whisky." Whisky may be dangerous to some men, but adulterated whisky is poison to all men. There was a case at Greenock some years ago in which a man paid 2s. 7d. for a bottle labelled "Finest Old Highland Whisky." That was found to be mixed with sulphuric acid to such an extent as to be dangerous to health. About the same time thirty samples of whisky were taken in various parts of Glasgow—only two of these were pure, the others contained wood naphtha, oil of vitriol, turpentine, sulphate of copper, shellac, and chlorine water. These are terrible things for Donald to reflect upon. The practical conclusion of all this is that you should support the public analyst even if it costs you a little trouble.

I shall now explain the sanitary law which has been made exclusively for Scotland. There are, on this subject, two parallel lines of legislation. As you might expect, the necessity for doing something was first felt in the towns; and accordingly the earliest sanitary law is to be found in those general Police Acts which were passed in 1833, 1850, and 1862; one object of which was to give an efficient municipal organization to burghs without town councils, and to other populous places. At the present moment I am concerned only with the last of these which is generally known as the Lindsay Act, its author being Mr. Lindsay, then Provost of Leith. That Act has been adopted by a great many of the burghs which have Town Councils, and, although we sometimes

laugh at the "scenes" which take place in our Town Councils, there is no doubt they have spent a great deal of energy and business talent in the public service, and especially in carrying out the sanitary law. But the Act may also be adopted by any town or village which has at least 700 inhabitants. It then becomes a Police Burgh, governed by commissioners who are elected on the principle of representation. There are already between eighty and ninety such Police Burghs in Scotland. Now, to a great extent, the Lindsay Act is a sanitary act. It was passed to make more effectual provision for lighting, cleansing, paving, draining, supplying water and making other improvements: all of which contribute most powerfully to the general health of the inhabitants. I am not, however, going to explain to you the ordinary administration of a Police Burgh. I am not going to discuss whether electricity should be substituted for gas: whether wooden pavements are better than stone; or whether street refuse should be used as manure upon a municipal farm, or should be disposed of by cremation, as has been recently suggested by an engineer in London. What interests you chiefly, as members of a Health Society, is the fact, that the commissioners may, if they think fit, appoint a person of competent skill and experience to be Officer of Health. The duty of that officer is to ascertain the existence of disease, especially of epidemic and contagious diseases, and to point out any local causes likely to injure the health of the inhabitants, and the best means of checking or preventing the spread of such diseases. I need not say how greatly Edinburgh has benefited by the appointment of such an officer. You all know Dr. Littlejohn. Not content with discharging the duties assigned to him, he has created new duties for himself. When that much abused Statute, the Edinburgh Municipal Act of 1879 was being put together, he procured the insertion in it of a clause compelling the notification of infectious diseases. That clause has been efficiently worked, and it has saved the city from much disease and death. How much you may imagine when I tell you that in the year 1881 alone the authorities received 3,206 reports from 155 medical men, or upon an average, nearly nine reports of infectious disease on every day of the year. The

Lindsay Act gives to the community large powers of constructing public sewers and supplying water. But it also imposes very serious obligations on private owners. All private, as well as public sewers and drains must be provided with proper traps, or some other covering, or means of ventilation, and no new house can be built without a proper system of drainage, by communication either with a public sewer or a private cesspool. The owner of every house, or part of a house, occupied by a separate family, is bound to introduce water to it by a pipe of not less than half-inch bore; and he is bound to keep the sinks and soil pipes in the most complete repair, so as to prevent any leakage or effluvium. He is also bound three times a week to clean out any court, yard, or area belonging to the house. The owners of common stairs and passages are bound to provide the proper means of ventilation, and to whitewash or paint whenever required by the authorities; and the tenants are bound to wash and sweep the landing-place and the steps below, at least once in every week; and if there is an accumulation of filth inside a house, the authorities may enter and have it cleaned at the owner's expense. If you wish to build a church, a theatre, a school, or any house which is intended to hold large numbers of people, you must first satisfy the authorities by what method of construction you propose to supply a sufficient quantity of fresh air. No securities for internal ventilation are taken in the case of private houses. Such is a rough outline of the sanitary law contained in "The General Police Act" of 1862. You will understand, of course, that many of the larger burghs have got Police Acts of their own, which are stronger and better than the General Act. But it is now generally felt that, as matter of public convenience, the sanitary law should be uniform over all the country.

But side by side with the Police Acts, which were confined to such towns and larger villages as took the trouble to adopt them, there was a series of compulsory sanitary statutes which applied to the whole surface of the country. These were The Nuisances Removal and Diseases Prevention Acts of 1846, 1848, and 1856, and The Burials Act of 1855. Not much was done

under these early Nuisance Acts. They were meagre and limited in scope, and there was no proper central authority to stimulate and direct the local administration. The English Sanitary Act of 1866 was intended to apply to Scotland, but it proved to be utterly unworkable; and when in the summer and autumn of that year cholera was raging through several parishes and towns, the defective state of the law relating to public health was seen to be a very serious evil. The Board of Supervision addressed a strong remonstrance to the Lord Advocate; and the result was that in the following year he passed The Public Health Act, 1867, which was written by Sheriff Monro, and is now the Code of Public Health in Scotland. Now, who are the authorities responsible for the execution of that Act? The Central Authority is the Board of Supervision, a board created in 1845 for the administration of the Poor Law. The local authorities are the town councils and police commissioners in towns, and the parochial Boards in rural places. The powers of the Board of Supervision are very large, but not so large as they should be. They are constantly being applied to by parochial boards for advice and information about the working of the Act. They have a very small and hard working staff of inspecting officers, who visit and report upon sanitary defects; and they have one medical officer who makes special reports. They also receive complaints from individuals against local authorities, and wherever a local authority fails in doing their manifest duty, the Board will take proceedings against them. Montrose, Galashiels, Forfar, Pittenweem, all these places have been brought before the Court and compelled to provide proper schemes of drainage and water supply. The Board of Supervision also frame bye-laws for regulating the duties of the sanitary inspectors and medical officers appointed by the local authorities. They have to consider the sites and plans of hospitals, and the applications to Government for sanitary loans; and in various matters they act as a court of appeal on points of administration. All this work is done very well considering the means at the disposal of the Board; and it is done at very little public cost, for the board has eight members,

of whom only one receives a salary, the others being the Provosts of Edinburgh and Glasgow, three sheriffs, and one law officer of the Crown. As regards the local authorities, by which I mean the rural parishes and the smaller towns—for the large towns give no trouble in these matters—the first business of a local authority is to appoint a sanitary inspector. Unfortunately this is not compulsory, except in towns or villages having a population above 2000: so that many hundred parishes are under no obligation to make any such appointment. In other cases, the duty is often evaded, or it is formally discharged by the appointment of a scavenger or a constable at a salary of £5, or less. There ought to be, but in too many cases there is not, a medical officer as well. After appointing their inspector, the next duty of the local authority is to put down all nuisances which he reports. Now, under this Act a wide meaning has been given to the word "nuisance." Take the case of inhabited buildings. The inspector is entitled to object to any *insufficiency of size, any defect of structure or ventilation, any want of repair or proper drainage, provided that makes the house either injurious to the health of the inmates or unfit for human habitation or use.* The words are vague, but you see they go a long way beyond The General Police Act. When the matter is brought before him, the sheriff may condemn anything which is not fit for human habitation: "*Any house or part of a house so overcrowded as to be dangerous or injurious to the health of the inmates.*" I am afraid that is the normal condition of a great many dwellings of the poor. Bear in mind that either to own or to occupy such a house is an offence against the public law. Here is another important definition: "*Any well or other water supply used as a beverage or in the preparation of human food, the water of which is so tainted with impurities or otherwise unwholesome as to be injurious to the health of persons using it, or calculated to promote or aggravate epidemic disease.*" These words contain the history of epidemic disease in a great many of the smaller towns and larger villages in Scotland. As houses multiply, the old wells and cisterns become contaminated with sewage, and things go from bad to worse, until a new water supply is introduced. "*Any accumulation of deposits from*

ashpits, or manure from town or village laid nearer than fifty yards to a public road or a dwelling house." There is no provision of the Act, I think, which is more frequently violated than this. The language of the Act is plain, and the mischief aimed at is very great; but it is one of those cases in which familiarity breeds an ill-founded contempt, and people seem quite content to live on in close vicinity to large masses of decomposing matter. One word upon the question of smoke. In Edinburgh we do not suffer so much from that nuisance as manufacturing cities do. But I cannot help thinking that there is a good deal of avoidable smoke in Edinburgh; and with that smoke is connected the fog which has visited us with increasing frequency of late years. Now, excessive smoke is prohibited by the common law of Scotland. It is further prohibited by a special Act of Parliament in 1857, which was confined, however, to the larger towns. The Act of 1867 has extended this wholesome regulation to the country districts. Nothing is provided with regard to private chimneys, but every fireplace or furnace used for trade or manufacture is a nuisance wherever situated, if it does not as far as practicable consume its own smoke; and every chimney is a nuisance if it is sending forth smoke so as to be injurious to health. Many a pleasant village has had its atmosphere darkened, its gardens injured, and its beauty destroyed by the volumes of black smoke which a little careful stoking would have avoided. On this subject I will merely mention that in 1881 a Committee of the Greenock Police Board made a very interesting report, in which they strongly recommend the universal adoption of mechanical stokers for the furnaces of public works. I think, however, that hand-firing would do well enough if the human stokers took a little more care. Closely allied to the smoke question, is the question of offensive trades; I mean such trades as tanning, skinning, blood boiling, tallow melting, and many others. You cannot start a new establishment of that unsavoury description within 500 yards of any burgh or village, unless you get the consent in writing of the Local Authority. The Local Authority often give that consent too readily; and then the Board of Supervision may interfere. One last form of nuisance has been

brought under our notice very recently in this city: "*Any place of sepulture so situated, or so crowded with bodies, or otherwise so conducted as to be offensive or injurious to health.*" It was under this section that the St Cuthbert's Churchyard was closed in 1874. Most of you, probably, have read the report upon the cemeteries of Edinburgh, which was published last month. That report disclosed two important facts. In the first place, it seems that many of the graves are much too near the surface. Some are only a few inches down, and a large percentage are less than two feet from the surface. Now the rule prescribed by public authority in 1863 was, that "No coffin should be buried in any unwalled grave within four feet of the ordinary level of the ground." If that were necessary for public safety in 1863, it is much more so now, when there is greater crowding of such places. In fact, the best modern authorities say that six feet is the minimum depth. In the second place, these cemeteries are overcrowded. You know that fourteen years is the period of safety in such matters. Well, I find that in Warriston, Dalry, Echobank, and Rosebank, there have been 51,586 interments in the last fourteen years, or more than 1250 to the acre. I think that constitutes a real danger, and I will merely remind you that under the Burials Act of 1855 the authorities have full power to provide a new and suitable burying-ground. We do not need to wait for the competition of new Metropolitan Cemetery companies.

Apart from all these particular nuisances the Local Authority have large general powers for the prevention and mitigation of disease. They may provide hospitals and proper buildings for the public disinfection of clothes and bedding. They may enforce the registration and thorough cleansing of lodging houses. They are bound to take measures for the proper drainage of their district, laying the cost as far as possible, on those who take benefit from the sewers; and facilities are given for the introduction of a water supply sufficient for the domestic use of the inhabitants. Such is the sanitary law contained in the great Act of 1867.

Two other matters I must mention, which do not belong to the Public Health Act, but which are administered for the most part by the same authorities. The first of these is the prevention

of the pollution of rivers, to which I briefly alluded when speaking of the common law. If you are interested in the beauty and purity of any stream, I wish you to remember this important fact. In 1874 it was reported to Parliament by a Royal Commission that "in every case efficient remedies exist and are available, so that the present use of rivers and running waters for the purpose of carrying off the sewage of towns and populous places and the refuse arising from industrial processes and manufactures can be prevented without risk to the public health or serious injury to such processes or manufactures." Accordingly, in 1876, an Act was passed which prohibits putting into a stream three things—(1) any polluting solid refuse, or waste, or putrid solid matter; (2) any solid or liquid sewage matter; (3) any poisonous, noxious, or polluting liquid proceeding from any factory or manufacturing process. Unfortunately, as regards the second and third kinds of pollution, the Act goes on to say that, if you were polluting a stream in 1876 you may go on doing so, if you use the best practicable and reasonably available means for making the pollution harmless. The Act does not explain the distinction between pollution which is harmful and pollution which is harmless, and it has therefore been of little use. It is indeed much less stringent than the common law. But we need all the help that we can get to prevent our rivers from being turned into public drains. You may have noticed that under this Act the Town Council of Portobello have stopped the pollution of the Figgate by the Pow Burn.

The second matter is the Compulsory Vaccination Act of 1863. You are aware that every child must be vaccinated within six months after birth. To meet the case of pauper children, and to give facilities for gratuitous vaccination, as a preventive measure against small-pox, the Act directs each Local Authority to appoint a public vaccinator; and it also established a central institution for the collection and distribution of vaccine lymph. It is amazing how much indifference and even resistance there is to this beneficent Act among the poor. For the year ending 20th June 1881 the number of defaulters reported by the parochial registrars was 7939, while the total number of persons vaccinated by the public vaccinators was only 2129.

I have now sketched the law of public health, and I wish you to consider for a moment how far the authorities have succeeded in putting that law in force. In the first place, I must admit that there has been a rapid development of sanitation in this country. In the year 1870, three years after the passing of the Act of 1867, the total receipts of the sanitary authorities of Scotland under that Act amounted to only £13,477. In 1881 these receipts had risen to £236,130, including loans, being an increase of 1750 per cent. In 1870 there was spent on water supply the sum of £8791; in 1881 it had increased to £95,121. The total expenditure from 1867 to 1881 has amounted to £1,572,417, of which £199,028 has been expended on drainage, £522,982 upon water supply, and £246,541 upon hospital accommodation. These figures represent what is done under the Public Health Act, but not what is done under other statutes, more especially in towns. For instance, in the year ending 15th May 1881, there was raised in the Scottish burghs a general police assessment amounting to £319,993, a sewerage assessment amounting to £34,991, a water assessment of £267,954, an improvement rate of £45,625, and a burial rate of £15,716. The great bulk of that money is raised for, and applied to, purposes which are directly or indirectly sanitary; and therefore I do not greatly overstate the case when I say that in the latest financial year, for which we have trustworthy figures, there was raised in Scotland by loan and assessment for sanitary purposes not much under £1,000,000. Now, when the population of Scotland is considered, that is no doubt a very considerable expenditure per head, but it would be a mistake to suppose that the law of public health is universally carried out in Scotland. It would be a truer thing to say that in the rural parishes it is not carried out at all. There are 882 parishes in Scotland, and in the year 1881 only 666 had done anything whatever under the Public Health Act. It has been said by a judge who has given much attention to these matters, that "in a very large number of parishes there has been complete neglect of administrative sanitary duties; in very few, indeed, have these duties been properly and zealously discharged;" and at a meeting of the British Medical

Association some years ago, at Inverness, it was stated that the Public Health Act is a dead letter in the north of Scotland. The same thing might be said of many parts of the Lowlands. Thus, in Berwickshire, only 17 parishes out of 32 have reached the stage of self-consciousness in this matter; in Dumfries, only 31 out of 43; and in Roxburgh, only 19 out of 32. A good deal of this apathy has arisen from the unfortunate idea, which has taken possession of many of the Parochial Boards, that the Public Health Act is a permissive act, that they are not bound to obey it and make themselves clean, but are entitled to remain dirty if they choose. I trust, if any of you have any influence in any part of the country, that you will help to destroy that mischievous delusion. The Public Health Act is universally binding on every Board and every individual in the country, and if they will not obey it, they may be compelled to do so. Then it is impossible to deny that the Parochial Boards are not very suitable authorities for public health. I do not refer to the political question whether they should be freely elected by the ratepayers. But I will tell you what the Board of Supervision said about them in 1867. "Many of them, altogether uninformed on such subjects, cannot appreciate the effects of filth and nuisance, of foul air and impure water in generating, propagating, and aggravating epidemic and endemic disease. The people generally are too much inclined to regard epidemic disease as a visitation which cannot by any precaution be averted; and they often object to be taxed for the removal of the most injurious sanitary defects, because they have all their lives been accustomed to them, and do not therefore regard them as evils. In such cases, the members of the local authority are sometimes unwilling to incur the odium of imposing the necessary rates, unless they can escape the consequent unpopularity, by shewing that they do so under legal compulsion. The men who are prepared to incur popular displeasure in order to do good to the people against their will are nowhere numerous, and when that displeasure may involve the loss of local dignity and emolument, are probably everywhere rare." The figures I have mentioned prove that the local authorities have shewn greater energy and public spirit during recent years, but it is certain that

the rural districts have suffered from their apathy. That is easily shewn by comparing the death rate in the rural districts with the death rate in the eight principal towns of Scotland during the decade 1869-78. These towns have vigorous and intelligent sanitary authorities; and many of them have extended sanitary powers under local acts. The death-rate in that period fell by twelve per cent. for the towns, but it rose by four per cent. for the country outside the towns. That is an emphatic commentary on a lax administration of the Public Health Act.

In conclusion let me say a word on proposed changes in sanitary law and administration. This formed the subject of a memorandum which in 1881 Lord Provost Ure of Glasgow sent to the other cities and large towns in Scotland. It was very much discussed in Glasgow in connection with the Police Bill for that City; and some of its provisions have been inserted in the general Police Bill, which the Lord Advocate is to introduce next session of Parliament. I have no doubt you will all agree to the main points of that memorandum. *First*, if overcrowding is ever to be got rid of, there must be more stringent and definite regulations with reference to the construction of houses and the free space round about them, so as to secure a free circulation of air. *Second*, the want of hospitals has led to innumerable evils, and therefore every district must have an hospital, and also proper arrangements for public washing and disinfection, including a reception house for healthy people, whose houses are being disinfected by the public authority. *Third*, the principle of the compulsory notification of disease, which has succeeded in Edinburgh, should be made universal. That is already proposed in Mr Hastings' Bill, which one Scottish member, Dr Farquharson, has promised to support. *Fourth*, you must have noticed that very often during the last few years sudden outbursts of enteric fever have been traced to the consumption of infected milk, and that the source of the contagion has generally been found in the unclean condition of some dairy-shop or farm. In Edinburgh our sanitary inspectors have power to examine such places, and the dairymen are bound to intimate to the medical officer the existence of infectious diseases on their premises, and the

sale of the milk can be prohibited. That power and duty should be extended to the whole of Scotland. At present there is nothing but an order of the Privy Council which has broken down in practice, and all recent experience shows that there must be some sanitary regulation of the milk trade. *Lastly*, you perhaps remember that, when I quoted some definitions of nuisance from the Public Health Act, these definitions generally ended with something about its being injurious to health. Sanitation has now become a science, and sanitarians say, I think justly, that if certain things are condemned as improper by sanitary science, local authorities should not be put to the trouble of proving in every case that the particular nuisance is injurious to health. So much for the amendment of the law. The administration also requires some change. In the first place, the central authority, the Board of Supervision, must be strengthened on the scientific side: otherwise we shall inevitably fall into the hands of the local Government Board in London. When that board was constituted some years ago, it was pointed out that it should have a chemist, an engineer, a statist, a lawyer and a doctor. Now the Board of Supervision lacks several of these elements. I hope these will be supplied, for I believe that in this, as in other matters, Scotland wishes to manage her own affairs. In the second place, the parish in Scotland is much too small a place to have a separate sanitary authority. In England the districts are much larger, and in consequence of that they not only get a stronger Board but are able to appoint a better class of inspectors, and to undertake more important sanitary works.

You will be glad to learn that I have finished. I have been speaking to you all night of rules and regulations. If I might be permitted to make a confession of my sanitary faith, it would be this:—Don't put your trust in rules and regulations. Study for yourselves the God-appointed laws of health; and when you have mastered their secrets, reverently obey them in your lives. Only in that way can you secure happiness at home and afford a good example to your neighbours.

Edinburgh Health Society.

HEALTH LECTURES

FOR THE PEOPLE.

Illustrated.

FOURTH SERIES.

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CONTENTS.

CIVIC SANITATION;

With Remarks on a City Ambulance.

By JOHN CHIENE, F.R.C.S.E.

My Lord Provost, Ladies, and Gentlemen,—

It is my privilege and my responsibility this evening to open the fourth session of one of the most important organisations in this city, the Health Society of Edinburgh. The programme of the lectures for the ensuing session has been published. Those who are to address you have chosen subjects of the highest interest. The syllabus speaks for itself, and requires no words of explanation or commendation from me. It would be presumptuous on my part to commend the lecturers: they are all well worth listening to; and I feel sure that, by regular attendance here on the Saturday evenings, you will learn much that will be useful, much that will enable you to lead healthier, and consequently happier lives. It will be my endeavour to-night to keep constantly before me the motto of your society; a motto written two hundred years ago: "*Thou that hast* Health (*says he*) *and know'st not how to prize it.—I'll teach thee what it is, that thou may'st love it better.*"—*Mainwayring*, A.D. 1683.

The special subject of lecture which I have chosen is, "A City Ambulance, or Speedy Aid to the Sick and Hurt." I cannot, however, forget that I open this session, and you will pardon me if, in the first instance, I say something to you regarding the scope of the Health Society of Edinburgh, and if I try and give you reasons for the existence of the Society.

The present age is one of enquiry, we are all taking less on trust, we wish to know the reason why anything is done, all knowledge is making great strides, no knowledge has made such advances as the science of sanitation. This Society is its child. Twenty years ago the public were beginning to recognise the great law that *public health means public wealth*, and as the result the Public Health Act of 1865 became law. In this Act certain extended powers were given to the Board of Supervision, which was first constituted in 1845. Local authorities were defined, and there was set in operation a number of laws and regulations having very important bearings on the health of the community.

During the last session of Parliament, Lord Advocate Balfour introduced an Act called the Burgh Police and Health Act for Scotland. The pressure of public business prevented this Act from becoming law. That Act will again be brought forward, and as members of the Health Society, it is your duty to take an interest in it, and to see that proper provisions are introduced which will make law those floating ideas which are the outcome of those advances which have been made in sanitary knowledge since the last Act was passed. Twenty years is a long time in this age of progress. These years have borne much fruit, which to a great extent is still ungathered. Take a deep interest in this question, and spend some of your political zeal in framing laws bearing on the preservation of your health.

The answer will be made to me—some of you are thinking of it now—that we have in our town a Municipal and Police Act, in which many sanitary clauses have been introduced; that this Act was passed as recently as 1879, and that, as far as Edinburgh is concerned, we require no Public Health Act. You surely are interested in the welfare of Scotland as a whole, and are not so foolish as to look on yourselves as entirely separate from your neighbours. You cannot pass by like the Levite of old. Do not most of you feel the necessity of a yearly holiday? You visit a health resort; do you always get health? Is it not notorious that you frequently contract diseases, the result of bad water, bad milk, bad drainage, and return to Edinburgh disgusted with your

vain and expensive endeavour to get renewed health for your daily work? This is one reason why you should take an interest in the general Act for Scotland. There is, however, another reason. The Municipal Act of 1879 is by no means perfect. Perfection is not of this world, and as citizens of no mean city, seize this opportunity to get various clauses in your own Act amended. If you lose this chance you may not have another for a quarter of a century.

I have not the time to discuss the Edinburgh Act fully; I almost wish I had, but it has been ordered otherwise. I gladly, however, avail myself, with your permission, of the great privilege afforded me as the person who has been chosen to open this session, and ask your consideration of some points in our Act which to my mind require alteration. I will in this way, I take it, best illustrate to you to-night the direction in which this Society can do good work.

The beauty of our city is dear to us, and of the utmost importance as bearing directly on our material prosperity. First, then, as regards the buildings that are now arising on every side, more especially on the outskirts of our city. Our esteemed Lord Provost, who takes so much interest in all questions connected with the amenity of Edinburgh, has lately told us that the rental of the city has increased nearly threefold, from £761,863 in 1854 to £1,893,696 in this year. The recent extension of the city boundaries has added house property assessed at upwards of £40,000. It is not the house property, however, on this new area to which I wish to direct your attention. I am not going to attempt to solve the difficult problem as to the best means to put new cloth into old garments; it is not an easy thing to remedy sanitary defects in old houses. Our public authorities are doing their best to remedy sanitary defects in houses; they are also endeavouring to close insanitary existing houses. We wish them all success in their difficult task.

It is on the ground that is still unfeued around our city that we must concentrate our thoughts at present. You see here a board with "ground to be feued," or a "building stance to feu." The proprietor desires to feu this ground; this is the

gentleman you have to deal with; his name is not on the board, but you can communicate with his law-agents. You are willing that he should get a fair profit, but you have to see that the feuing plan is so laid out that your interests are attended to. I am of opinion that a proprietor should not be allowed to cover to the very utmost his ground with tall, often ungainly tenements, which will soon be inhabited by a dense population, from whom, in a very few years, a clamour for recreation ground for air space, will arise. An open space is as necessary to a crowded locality as a lung is to a human body. This cry has already gone forth regarding the central parts of our city, and it has to be met *at your expense.* This you cannot help, but surely you are entitled to take some action with regard to the feuing plans which are now being laid out. If you do not see to it that every proprietor is bound by law to provide facilities for recreation ground, for air space, in a very few years the very same cry will arise from ground which is now open fields. Feuing plans are now being laid down, ground is being covered to the utmost limit of the law with buildings. Its utmost capacity is being utilised, as the phrase goes, by the speculator. I do not blame him. The future amenity of the district is not considered for a single moment. It is not his business; present profit, a large rental to him, a large feu-duty to the original proprietor, is the sole aim and object of those interested. As a result our city rental is rising rapidly; we are spending our air capital to attain this object. Is it altogether an unmixed good that it should be so? Are we doing what every sound public company does? Are we laying aside, so to speak, a reserve fund against the future? Are we not congratulating ourselves unduly on our increasing rental, our yearly profits, our present large interest, and forgetting the future when we will be called upon to spend our capital in purchasing air spaces for these crowded localities? From a paper by Dr Watt, on the statistics of the sick-rate of Friendly Societies in England, I gather that the sick-rate in our large towns (I do not necessarily include Edinburgh in this), is 36 per cent. in excess of the sick-rate in our rural districts.* To what is this tremen-

* If we adopt the sickness measure of the Friendly Societies, we shall end much work for sanitarians to do, in order to bring up large towns to

dous difference due? I answer, without hesitation, to the insufficient lung space in our towns.

I do not think that we should altogether selfishly overlook in this consideration the surrounding proprietors who have been content with a smaller return, and who have erected villas, and semi-detached houses, with garden ground and air space. Are the occupiers of these villas to have no consideration shown them? This, then, is an evil. You ask the remedy? *All feuing plans should pass through the hands of that most important committee, the Public Health Committee, before they are passed.*

Now, as regards the buildings themselves, they are under the control of the Dean of Guild Court. This Court is to my mind too much under the finger and thumb of the builders. We appoint builders to watch our builders. I for one would like to see fewer builders on it. Our Edinburgh houses are generally sound. Are they always as sanitary as they should be? Public opinion is now beginning to have its say on this matter, and builders are beginning to find out that many people are chary of occupying houses with distinct sanitary errors. As you are well aware, of late years building was overdone. Now, however, the demand is equal to the supply. A few years ago the demand exceeded the supply, and rows and blocks of houses were erected for the middle classes with all the sanitary water arrangements in the centre of the house. At any time a similar demand may arise, nay, will arise, if our Provost's anticipations with regard to the growth of the rental are correct; and this mischievous water centrality will again be the rule. Place the water closets in the centre of the house, carry necessarily the soil pipe down the centre of the

the position of the rural districts, where we know that except for out-door occupations, the means of health are not greater than in large towns; and we must not forget that a very considerable proportion of town members of Benefit Societies are also employed in out-door occupation. The average excess during the best years of life, say from twenty to fifty, is about 36·58 per cent., and seeing that members of Friendly Societies are a select class, we may safely conclude that the sickness of the outsiders, especially in large towns, is much greater. (Manchester Health Lectures, Series 1878-79, No. 7. "The Loss of Wealth by the Loss of Health," by John Watt, Ph.D.)

tenement, in its coffin of plaster, and the danger of sewer gas escaping from any leak is rendered doubly hazardous, because the imperfect joint cannot be easily discovered; *not to mention the difficulty of ventilating these darkened closets with borrowed lights.* The common stair is very often the common ventilating shaft; it often is itself central, and is very frequently itself unventilated. Such houses are now being erected for working men. *Our workmen are the mainstay* of the country. *Good health is necessary to good work.* The extension of our tramways, the opening of our suburban railway will open up large tracts of ground, our working classes will migrate to our outskirts. Let us see to the houses that are erected for their accommodation. A healthy home for the working man is one of the questions of the present day.

I would ask you to visit Craigmillar Castle if you wish to study the past wisdom of our architects 400 years ago. If you wish to know present opinion, look to Leeds, for example, on this matter. Let us not forget that Leeds is the town of one of our greatest sanitary reformers of the present day, and I am proud of the fact that Mr Teale is also one of the greatest authorities on surgery of the present day. Here is the Leeds bye-law: "Every person who shall construct a water closet in a building shall construct it in such a position that one of its sides at the least shall be an external wall. The window of the closet shall be at least 2 feet by 1 foot, exclusive of the frame, and opening directly into the external air." Specific laws are laid down with regard to an efficient constant system of ventilation of these closets. The Lord-Advocate says: "Every water closet shall be placed in such a position that one of its sides shall be an external wall, with a window therein, containing an area of at least 6 superficial feet, one half of which shall be made to open." No pigeonholes such as you will see in the court-yard of the building in which we are now met. But, gentlemen, you have not to go to Leeds; you have the very same law at your hand in Leith, thanks to the sagacity of a former Provost of the Burgh, Dr Henderson. Proprietors and builders did not like it, but he persevered and gained his point, all honour to him for it. It is a humiliating

fact—*Edinburgh has as yet no such law.* This is a disgrace to our fair city : this also is an evil, and must be amended.

Now as regards the height of our buildings, the tenement may, according to our Act, be one and a half times as high as the breadth of the street. In most English towns, in London for example, where surely land is as valuable as in Edinburgh, the tenement can only be in height equal to the breadth of the street. In the Lord Advocate's bill, the same sanitary standard is distinctly laid down. Sunlight is an essential to a healthy existence. We do our best to keep it out. In the London Act the new street must be 40 feet wide ; in the Lord Advocate's bill, 36 feet wide ; in the Edinburgh Act, 20 feet wide. I do not, however, lay stress on this remarkable lowering of the sanitary standard. The speculator does not avail himself of this permission, because a house 30 feet high is not enough to recoup him for the original heavy price paid for the land.

In the Lord Advocate's Act, " every building used as a dwelling house shall have directly attached thereto, in the rear of or at the side thereof, an open space *exclusively* belonging thereto, equal to at least *three-fourths* of the area to be occupied by the intended building." The Edinburgh Act says that " the open space shall be equal to at least *one half* of the area to be occupied by the intended house." Even this levelling down of the sanitary standard is not enough, because in the same clause we have the most unfortunate rider that in cases " where the thorough ventilation of such house is otherwise secured, or *under other special circumstances*," the said Dean of Guild Court, with its preponderance of builders, may allow the open space to be reduced in limits. These laws, lowering the sanitary standard, have a most baneful effect. A proprietor has a piece of ground ; he desires very naturally to get the best price for it, we cannot blame him. He employs an architect, and that gentleman, *with our Municipal Act of* 1879 *as his standard*, makes a calculation, and a proportionate feu-duty is demanded. The speculator now steps in, and he makes a similar calculation, and trusting perchance to the help of his friends in the Dean of Guild Court, he hopes that his case may be one of those under " special circumstances." He takes

the ground and proceeds to build as near the law as he thinks the public will stand. Alter these laws, and the whole aspect of affairs is changed. Houses will be healthier, not dearer. The proprietor asks less, gets less, the speculator pays less, and he can therefore afford to spend money to make houses healthier.

Lastly, if I do not weary you, are those blocks of high dwelling-houses surrounding an air space, without any outlet whatever for bad air, inlet for good air, that are arising around us,—look at Dalry, Warrender Park, and along the side of the canal,—in accordance with common principles of sanitation? Our Act arranges for sufficient ingress and egress to and from our public buildings: does it also see to a sufficient circulation of air in these *air-wells*—or rather *airless wells*—which are arising on every side? *

I now take up our dairies and our milk shops. Milk is a sponge, and a dangerous sponge. It absorbs at once any deleterious matter, and is one of the most fertile causes of epidemics. In a paper by Mr Hart, read before the Health Department of the Social Science Congress in Glasgow, he analyses 53 outbreaks of typhoid fever, 17 of scarlet fever, and 12 of diphtheria due to milk. The milk epidemics in question had attacked in round numbers 3500 with typhoid, 880 with scarlet fever, and 700 with diphtheria. These cases have all occurred within the last twelve years. Mr Vacher in a paper says that nearly 100 epidemics have been traced to milk. The dairies and milk shops are well worth consideration. Our town dairies are inspected, and much good has recently been done by our energetic Officer of Health and his assistants. I cannot help thinking, however, that he would be thankful for more assistance. He should have under him an assistant medical officer to undertake this important duty. In the dairies in the town, that most excellent clause in

* I was informed after the lecture that there is a salutary law in force in Glasgow, whereby a method of ventilating these spaces is secured. In a block of buildings at Rosemount, Gardner's Crescent, ventilation to the enclosed air-space is obtained by open passages at the four corners. A more thorough way would be to have a complete opening at the four corners of every "airless well."—J. C.

our Municipal Act, referring to the registration of infectious diseases, enables the Medical Officer of Health to put his finger at once on any case of infectious disease occurring in a dairy within the burgh. Much of the milk, however, sold in Edinburgh comes from dairies outside the city: over them he has no such power. He may never be aware, until much mischief is done. We may have at any time a repetition of what occurred not so very long ago in the Morningside district. Dundee is at present suffering from two epidemics, one of scarlet fever, and one of typhoid, both originating from infected milk. The Lord Advocate desires to extend the same law with regard to the registration of infectious diseases to the whole of Scotland. Give him your individual assistance in this matter, and the result no doubt will be a stamping out of milk epidemics. They will be strangled at their very beginning. I have spoken of the necessity of attending to the sanitary standard of health resorts as one reason why you should take an interest in the Lord Advocate's Act; the rural dairies is surely another reason for your interest in this matter.

There is much room for improvement in our milk shops where milk is sold. No milk shop should have any connection with an inhabited house. There should be no possibility of sewer gas reaching the basins of milk. All milk shops should be licensed, as in Birmingham. Keep a sharp lookout on your milk cart, and see that it is not utilized for carrying pig's meat.

I have not time to speak of painters and servants being allowed to go outside windows to clean them without some protection. I have not time to speak of smoke nuisances. I have not time to speak of the importance of inspecting plumber work when building operations are going on. I have not time to speak of the importance of public baths and wash-houses. I have not time to speak of lodging houses. Common lodging houses, where a person pays fourpence a night, are well taken care of; what of the lodging houses of our students, clerks, shopmen, and shop-girls? All lodgings should, in my opinion, be periodically inspected and officially registered. This, no doubt, means money spent, but it would be money saved. Every case of fever treated

in the city hospital costs a considerable sum. From information supplied me by Mr Fasson of the Royal Infirmary, and Dr Wood, Resident Physician of the Fever Hospital, I find that on an average every case of scarlet fever admitted costs £8, 4s. 7d., and every case of typhoid fever costs £7, 1s. 6d. Every case that is prevented is money saved, and would fully compensate the town for the expense of inspection.

As regards infectious diseases, it is right to tell you that in Leith, ten years ago, Dr Henderson, to whom I have already referred, called on the medical men in the town, and with their hearty approval instituted an excellent plan for registering disease and preventing epidemics. Dr Littlejohn has taken a very great interest in this important matter, and he has now a most efficient system in full working order in Edinburgh. He has, like all reformers, had to bear considerable odium, and has been required to support his system against attacks, I am sorry to say, from medical men in many parts of England. He deserves our hearty approval and cordial co-operation. Dr Littlejohn has kindly supplied me with statistics, which enable me to show you the great amount of good work that is being done by his system of notification. It has been in force now for more than three years, and from it we learn that during the years of 1880-81-82, 15,913 cases of infectious diseases were intimated. Of these, 1258 cases were removed to hospital, and in those cases treated at home, any case was fully enquired into by the Medical Officer of Health, *when the medical man who intimated the case considered it necessary.*

I come now to the subject of my lecture. I hope I have not wearied you with these introductory remarks. The magistrates of the city have power to remove to an hospital any person labouring under infectious disease who cannot be properly isolated at his own home. They provide and maintain a carriage or carriages for this purpose, and pay the expenses of conveying the patients to the hospital. It is not my intention to-night to say anything further with reference to a city ambulance for the conveyance of patients suffering from an infectious disease. Further than that, it should be at once comfortable and cheerful, and non-funereal

in appearance. It is, however, my intention to bring under the notice of this influential meeting the importance of speedy aid to those who are hurt, and to those who are taken suddenly ill in our streets. At present in such cases such persons come under the care of sympathising bystanders or the police, none of whom have received any instruction whatever in what is now commonly known as "first aid to the sick or wounded." (Ambulance drill has recently been taught to some of the members of the volunteer corps of our town.) The person is placed either in a cab or on a police stretcher. I can imagine nothing worse adapted for the conveyance of a patient with a fractured limb than a cab. Endeavouring to get information upon this point, I asked the surgical porter (David Ramage) at the Royal Infirmary about it, when he said, "An open cab is bad enough, a closed cab is worse, but by far the worst of all is a hansom." There is difficulty in getting the injured person into the cab, there is difficulty in getting him out of the cab when he reaches the Infirmary or his own home. In the case of a fractured limb, the fracture may be changed from a simple to a compound one. The patient's stay in hospital will thereby be much prolonged, his chances of ultimate recovery greatly lessened, and his life endangered. In cases of persons suffering from faintness, as the result of heart disease, the sitting posture may make all the difference between life and death. In the case of the police-stretcher, the only advantage it has is the recumbent posture of the patient; in every other particular it is a most inefficient means of conveyance. The individual is exposed to the gaze of passers by. A crowd of boys follow the stretcher, the policemen who carry it convey the idea that the person is incapable from causes which cannot be classed as accidental, his progress through the streets is slow, and if he is wounded much blood may be lost, and he may arrive at the hospital, or his own home, in a most unsatisfactory condition. I have not overdrawn this picture. I have not been a surgeon in Edinburgh for twenty years without having seen cases that have suffered from all these evils, and I ask if the time has not come when we should try and find some remedy. In London,

the St John Ambulance Association has been in existence for seven years. In Glasgow, the St Andrew's Ambulance Association is now in full working order, and surely Edinburgh, with all its charitable organizations, with its important hospitals, with the largest medical school in Great Britain, should not be behind in this important matter. During the last three years an average of 720 cases of accident each year have been treated as in-patients in the Edinburgh Royal Infirmary; many other cases have been taken there, their wounds and injuries dressed, and afterwards sent to their own homes. Many cases of accident are conveyed directly to their own homes; many cases of sudden illness are conveyed in the imperfect manner to which I have referred, either to the hospital or their own homes, and I do not think that I am over-estimating it when I say that 1000 cases occur every year in Edinburgh which would benefit from a speedy and comfortable means of conveyance from the place of accident to the place of treatment.

I lately visited Glasgow with your honorary secretary, Mr W. A. Smith, in order that we might see for ourselves the working of this Association. We received every information and much courtesy from Mr W. M. Cunningham, the secretary, and from Drs Beatson and Whitson, who have from the first taken much interest in ambulance work. Let me rapidly sketch to you what the organization in Glasgow aims at.

The Glasgow Association undertakes two distinct pieces of work. First, they send lecturers to different districts of Glasgow, who give instruction to artizans and the citizens generally as to the best methods to relieve suffering, until either a medical man reaches the patient or the patient reaches a medical man. These lectures are termed "First Aid to the Injured." Systematic instruction is given, and any one who proves himself capable gets a certificate, stating that he is qualified to give first aid to the injured.

This certificate each man carries in his pocket, and shows by being the possessor of it that he is able to assist in cases of accident. He has been taught how to stop bleeding, how to treat with simple means a broken bone, how to lift a patient so as to do him no harm, how, in short, to make him as comfortable as pos-

sible in his unfortunate position. Many of these classes have been attended by the workmen at the public works, and there are now in Glasgow 131 certificated men (many others have some knowledge) spread all over the city, who can at once give efficient help in a case of accident. This help is appreciated, as you may have seen in the papers, that each member of the Ambulance Corps in attendance at the time of the Daphne disaster was presented with a handsome time-piece.

Second, when an accident has occurred a telegraphic or telephonic message is sent to 93 West Regent Street, the office of the Association, stating that an accident has occurred, and asking immediate assistance. There is close at hand a stable with a horse, and very shortly the horse ambulance is at the door (Mr Smith, your Secretary, timed it and found it to be six minutes). It is at once despatched, under the charge of a thoroughly trained attendant, to the scene of the accident. An ambulance box containing splints, bandages, &c., is kept at some of the large public works, so that temporary relief may be afforded before the arrival of the waggon. There are two of these ambulance waggons in Glasgow, and there is an attendant ready by day or by night at the Association Office, whose duty it is to accompany the ambulance, and render aid to the injured person during his conveyance to the hospital. The Association undertakes to send at once the Ambulance waggon to any accident within the burgh boundaries. During last year, the first year of the Society's existence, much good work was done by them.

No cases of infectious disease are carried, but patients are frequently carried from the hospital to their own homes; and during the hours when the principal works are closed, when accidents do not frequently occur, the ambulance waggons may be obtained to convey sick people to the railway station, or to places beyond the city boundaries, and at term time they are in much request in removing people who are unable to go in cabs to their new homes. I have satisfied myself on evidence that cannot be gainsaid (the daily papers speak highly of its value), that this Association is doing much good in Glasgow. I think Edinburgh is behind the age, and the time has arrived for the formation of a

similar Society, with a double function, *first*, to train the citizens in ambulance work, showing them how to give first aid to the injured, how to help their fellow-men who are suffering, and *second*, to supply a speedy, comfortable means of conveyance from the scene of the accident to the place of treatment.

I trust that the members of the Health Society will by their interest in this matter give the good cause a start: if it is once begun the system will go on. It has all the elements of success, because good is done by it. Edinburgh is not so large as Glasgow, and a horse ambulance might be a subject for future consideration after the Society became fairly organised, and a good start had been made. The Society in Edinburgh might begin with the lectures, train the citizens, educate the police and firemen, a matter of primary importance, and encourage the doctrine of the necessity for a more speedy and rational method of removal than we can at present boast of. Much good might be done by supplying each police station and each railway station with a litter, which is just a couple of wheels with india-rubber tyres, fitted on to a frame on which a stretcher with a light gauze covering can be placed. By this means all accidents would be speedily removed to hospital. Our authorities would allow them to pass along the pavements, and the injured person would arrive in a much better condition and with much less suffering than he does at present.

Mr Wilkins, our much respected fire-master, has arranged a litter by cheaply converting the old police-barrow. This conveyance is at the Police Office in High Street, and is chiefly used by persons under the influence of alcohol. I am glad to inform you that he is now occupied in making a light easy running litter. From his well-known ingenuity, we have every reason to hope for a most efficient machine. If one of these litters was placed at each of the police stations and fire stations, and if the post-office authorities would kindly put a red-cross on the post-office map at each of the points where a litter is kept, then in every case of sudden illness or accident it could be obtained, and the patient conveyed in half the time that he is at present to the place of treatment. Through the courtesy of Professor Annandale,

Chairman of the Committee of this Society, I have seen drawings of an excellent and commodious ambulance waggon now in use in Newcastle. It is suitable for either infectious diseases or accidents, and has been built under the superintendence of Dr Armstrong, Medical Officer of Health for Newcastle. It is made by Messrs Atkinson and Philipson, coach builders, of Newcastle. It has none of the funereal aspect so often seen in ambulance waggons used for carrying people suffering from infectious diseases to hospital.

I trust that I have said enough to encourage some one to take the matter up. I will give all the help I can. Mr Cunningham, the Secretary of the Glasgow Association, has the cause at heart, and I am sure that Mr Miller, one of the surgeons in the Edinburgh Infimary, and Dr P. A. Young, both of whom have already given Ambulance Lectures to volunteers in this city, would give their hearty help. Many of our junior practitioners and senior students would, I am sure, assist as lecturers, and we would soon have in Edinburgh a ready band of certificated assistants, who would give efficient first aid to any one who is injured, and would assist the police in removing them to the hospital or their own homes. It is wonderful the amount of latent sympathy in the world. I trust I have put the match to it to-night, and I hope soon to see an ambulance organisation worthy of this important city.*

In conclusion, there is no greater mistake than to suppose that lectures are the only object of this Society. It desires to do what it can towards the preservation of your health, and the lectures are only one means to that end. It exists with a larger object of endeavouring to form in this city and its neighbourhood a strong and healthy public opinion in favour of the observance of the

* At this point a demonstration on "speedy aid to the hurt" was gone through by five members of the audience, who had received a lesson in ambulance drill during the afternoon. The litter used was composed of a pair of tricycle wheels, two coach springs, and to each of these a piece of wood was attached; over this was fixed the stretcher. The supposed wounded person was promptly treated and lifted on to the stretcher. This stretcher is on view at Messrs Liddle & Johnston's (coach builders) show-rooms, Grindlay Street, until December 1, 1883.—J. C.

sacred laws of health prescribed by God and man. The members believe that much of the social misery in existence, is due to the non-observance of these laws. With this end in view it desires to provide subjects of interest to the mind, and to encourage proper amusements and physical exercises. It desires to assist the constituted authorities in the promotion of sanitary improvements. With these objects in view, it desires that everyone present should become a member. By so doing, he will be directly assisting, by his influence and co-operation, the objects of this Society. If he holds aloof he will be retarding these objects, not by direct opposition which can be met, but by that most difficult of all oppositions—a careless indifference, which it is most difficult to meet. You will perhaps ask, What can I do? You under-estimate your power. Public opinion is the only efficient factor by which any change can be brought about. Indifference on the part of the public means failure; earnestness is certain success. Your town councillors and your members of Parliament are elected to carry out your wishes. Every public man is the servant of the public. When he finds that the majority, or even a powerful untiring minority, are in earnest about any thing, then that thing will be done. In electing your public men, let them understand that money spent in preventing disease is one of the most important and most economical things that they can do. Show them that disease means expense, that health means economy. Referring again to Dr Watt's lecture on the "Loss of Wealth by the loss of Health," he states:—"The experience of Friendly Societies, according to Mr Neison (1867), shows an average of about 2·45 weeks per annum per member for all ages between twenty-one and seventy years. But we have to include in our calculations the less prudent men, who are not members of Friendly Societies, and we may therefore safely assume an average sickness of 2½ working weeks per annum, and then we shall find that by loss of work through sickness the working men lose no less than £13,306,687 per annum; and if we add 25 per cent. to that sum for the losses of employers and dealers by lessened trade, we shall find a loss to society the measure of which is £16,633,359, or £1,108,890 for each day of sickness.

And for every day that we can lessen the average sickness of the heads of families in England and Wales, we shall add to the wealth of the country by more than a million sterling." Let them know that you are in earnest in preventing epidemics; that epidemics are preventable; that social misery can be lessened; that when epidemics get the mastery, then the expenditure is increased—directly, by money spent in combating the evil, indirectly, by keeping bread-winners from their work;—and enabling them by their wages to keep back poverty, to lessen the poor-rates and police rates, which exist in consequence of disease and misery, the direct result of breaking those laws which this Society inculcates. To-day, with an ordinary amount of sickness, and with no epidemics, we are directly paying away the yearly sum of over £40,000 in two diseases only—scarlet fever and typhoid fever. (See Appendix.) This, remember, is a calculation based on the number of cases that have been intimated to the Medical Officer of Health within the city boundaries during the past three years, during which time Edinburgh has been free from any marked epidemic. This sum is only the *primary* expense; it takes no account of secondary losses—inactivity during prolonged convalesence, of the results that frequently follow these diseases, of the loss to employers during the absence of the employees, of death and its immediate results, and of its incalculable secondary far-reaching results, when the heads of families have been removed, and their wives rendered widows, their children orphans. This is a sum equal to 5d. per £ on the city rental. It is ½d. in the £ more than we are paying for poor-rates. How anxiously do we watch for the reduction of our city taxes, how grudgingly do we pay ½d. in the £ more. Yet it is true that we are allowing ourselves to spend yearly an amount equal to 5d. in the £ on a sick rate in two diseases only, and we utter no complaint.

Educate a man to the evils of drink, and the drunkard ceases from our streets. Go into our hospital on a Saturday night, and observe the accidents; the great majority occur to those who are overcome by drink. Not only does the drunkard fill the hospital wards, but he fills the police cells, emptying in

the one case the pockets of the charitable, emptying in the other the pockets of the ratepayers. Surely this is a preventable evil. To take another example, spare no money in endeavouring to get a supply of pure milk. Let us also look to our schools; let us see that our children are not sitting beside members of an infected house. Place no obstacles in the way of the Corporation; encourage them to found hospitals for infectious diseases. I hope soon to see a well-regulated convalescent home for children and adults recovering from scarlet fever. Strengthen, by every means in your power, the hands of your Medical Officer of Health; assist him in every way you can in his endeavour to strangle and stamp out infectious diseases in their beginnings, welcome him when disease has come, and consult with him as to the best means of disinfection. Do not be misled, there is a great deal of foolish talk about the liberty of the subject, in this connection it is just another word for selfishness. It is a false liberty, which means slavery to your neighbour. Self-denial goes hand in hand with true liberty. By all means let us retain our liberty. It is unnecessary to tell a Scottish audience that our liberties are dear to us, but one man's selfish interests may be another man's poison, one man's liberty may be another man's hurt. A person is not at liberty to poison his neighbour's food. So also a man should not be allowed to injure or to give disease to his neighbours.

By those who are satisfied with our present condition, you will be told that our death rate is now very low. I grant this, but no one will deny that there is still much room for improvement. Surely this town, with all its natural advantages, is not going to take unhealthy towns as its standard. It must aim at being classed with the rural districts.

But further, *the death rate is not necessarily a criterion of the sick rate*, as the following figures, supplied me by Dr Littlejohn amply testify:—

	1880.	1881.	1882.	
Typhus,	38·88 °/o	60·86 °/o	22·22 °/o	Table shewing the per centage rate of deaths of those attacked.
Typhoid,	12·79 ,,	11·38 ,,	11·11 ,,	
Diphtheria,	19·82 ,,	26·90 ,,	15·20 ,,	
Measles,	5·97 ,,	3·18 ,,	2·12 ,,	
Scarlet Fever,	16·65 ,,	13·18 ,,	4·26 ,,	

Sickness means expense, anxiety, and discomfort. A time will come when all sicknesses are registered; the expense will be a flea-bite compared with the valuable lessons taught. *To meet an evil, we must know it thoroughly,*—where it lurks, whom it attacks, the sort of climate it prefers, &c. The relation of the science of meteorology to the sick rate has already received some attention from Dr Arthur Mitchell, and I think much good work can still be done in this direction.

This Society has another use, it desires to increase our general knowledge, which is daily becoming more and more necessary. There is at present, on the one hand, a tendency to centralisation: a central governing body in London is to manage everything. The experience of the last few years, however, is educating public opinion in an opposite direction. People are beginning to see that the Imperial Parliament has its hands full, and as an outcome of this belief, a reaction is taking place, and we will soon see a farther development in the direction of local government. Each community is anxious to manage its own affairs; people are beginning to take care of themselves. Smiles' "Self Help" is, I see, the favourite book in one of our public libraries. This is a good sign. Help yourselves, do not look to State aid; you are called upon individually through your Town Council, a body of hard working, well abused men—I, for one, have no sympathy whatever with the abuse—to take your share in the settlement of many questions which were formerly under State control, or unattended to altogether. There are many things that you will need to look to: one of the most important is the health of the community. In order to attend to these things, you must understand what is required; you must have a standard of sanitation, which it will be your individual duty to keep intact. This Society is a most powerful factor in this education. Let each one, every one present, join the Health Society of Edinburgh, and let him see that he takes his share in the education of the general community to a healthy public opinion, which has for its motto, PUBLIC HEALTH IS PUBLIC WEALTH.

APPENDIX.

(*a*) For every case of scarlet or typhoid fever admitted to hospital, each case of scarlet fever costs the hospital, ratepayers, and charitable public, on an average, £8, 4s. 7d. Each typhoid fever case costs £7, 1s. 6d. The average cost of these two for each person is £7, 13s. On an average of the last three years, 296 persons were admitted yearly to hospital for one or other of these fevers; and 296 persons at £7, 13s., . =	£2,264	0	0
(*b*) Not treated in hospital, but on an average of cases reported to Medical Officer during the last three years, there were 2120 cases a-year treated at home. This, at the hospital rate of £7, 13s. for nursing, medicine, food, &c., =	16,218	0	0
(*c*) These 2120 persons must have had medical advice, and allowing for each person the sum of £5 for their account with the medical practitioner, . . . =	10,600	0	0
(*d*) Of 2120 persons sick at home, we may say that one-third of these are bread-winners, earning, let us say, £100 per annum. Allowing each person to be laid aside for two months, the loss =	11,777	0	0
(*e*) Of 296 persons sick with fever in hospital we may say that one-half are bread-winners, earning £50 per annum. These being laid aside from their labour for two months, . =	1,184	0	0
	£42,043	0	0

N.B.—In these calculations only typhoid and scarlet fever have been taken into consideration, and the yearly estimate of numbers is derived from statistics received from Dr Littlejohn during the past three years.

THE GROWTH AND DEVELOPMENT OF A CHILD IN BODY AND MIND.

By T. S. CLOUSTON, M.D.

The subject of the growth and development of a human being in body and mind from the period of birth up to maturity is one of the most interesting in the whole range of knowledge. Its practical importance is at least equal to its interest. To all classes of men and women it is a problem of vast importance. The student of mind, the student of body, the educationalist, the sociologist, the statesman, the clergyman, the brain worker, the craftsman—all should regard it as one about which we cannot know too much, and one in regard to which every increase of our knowledge necessarily tends towards human welfare and happiness. But beyond and above all these stands the parent, with an interest in the problem that is intensified by the keenest and tenderest of all human affections. What feeling is so keen as a mother's interest in her child's growth and gradual development? Has not every new fact in this process in the case of almost every child whose mother was there to see it, been observed and talked of ever since the world began? Was there ever any fact in a child's development too small for a mother's notice, or too unimportant to excite her interest? If all the observation of all the men of science since the beginning of creation on any subject that they have ever studied were measured, and if all the pleasure that that study has given were estimated, the sum would not amount to a millionth part of the attention and pleasure that the mothers of the world give and derive in one year from

watching their children grow in body and mind. The rapture of the man of science when he makes a new discovery is a tame feeling compared with the mother's joy when she sees her baby's first smile.

With this ceaseless observation, this vivid interest in the matter, it would be thought an impossible thing that our knowledge of the process and details of the mental and bodily growth of children should still have anything to be added to it, or should be lacking in fulness or precision. It might be thought that on this subject, at least, the instinctive power of observation of the parent, stimulated by such affection, would not need the trained mind of the man of science to help it in seeing the facts. A process that has gone on before the eyes of every parent during all time should have needed no elucidation from nineteenth century philosophers. All this abundance of opportunity might have been supposed to produce a glut of knowledge. Yet what are the facts? This most accessible field of study has been almost utterly neglected, at least till of late years. The fathers and mothers whose very lives have been bound up in the process of their children's development have been grossly inattentive to the ordinary facts, and blind beyond belief to their significance. The philosophers speculated about mind till they lost themselves in their own mental subtilities. Yet they failed to observe the gradual evolution of the minds of their children, where they would have seen mental facts more important than many of those obtained through their own introspection. The physiologists even were long content with studying the fully developed human being and neglected the process of his gradual growth. The teacher was mostly content with regarding children as mentally non-existent till they could learn and say their A B C. He classified their mental evolution thereafter by their capacity for reading, grammar, and languages; he commonly resented individual and hereditary peculiarities as the outcomes of original sin; and he often ignored the bodily development as a thing he had nothing to do with, and that had nothing to do with what he called "education" at all. The statesman till lately did not seem to concern

himself much with the making of a people. Nature was supposed to take entire charge of the development of men and women up to the ages when the schoolmaster and the policeman took them in charge ; she making them into big and small, strong and weak, wise and foolish specimens, irrespective of human intervention, or the conditions under which they grew. Fortunately some of our statesmen have now arrived at a different mode of looking at the question.

The best way to realize our past inattention to the development of our children is to ask any intelligent educated father or mother or nurse, who have seen many children grow up, to tell you about how many pounds avoirdupois a healthy child should grow each year, and how many inches in height it should make each year till full growth is attained. These are very simple and easily ascertained facts, and most important ones. Yet how many times are they observed and noted? If the rate of body growth is not observed by the parent, how can any arrest of that growth be detected in time to remove its cause at once ? My experience is that stoppages in the growth and proper development of children are usually not observed till they have gone too far to be easily remedied and their causes removed. If we ask this parent further the ages at which the faculties of memory and observation, or imitation, anger, and fear were first observed, and the time of life at which ideas of colour, form, and space are first developed, I fear we should get very unsatisfactory replies; or if we asked these same intelligent parents to give us some idea of the special mental and bodily characteristics of each alternate year of their children's lives from the first to the sixteenth, I should not be sanguine as to either the clearness or correctness of the answers. I should back an enthusiastic dog fancier to give a far more exact account of the development of a bull pup and his mental and bodily characteristics from his first months of life onwards.

With all this opportunity for parental observation during centuries, it was after all reserved for men of science to make the first careful and exact records of the mental and bodily development of children. Darwin, the greatest observer of nature and the profoundest intellect of the time, in the midst of his studies

of plants and animals, of the earth itself, and of their laws, did not neglect the study of his own children. In the year 1840 he began to make a minute series of observations on the mental development of one of his own children, from the first day of its birth onward, recording and interpreting the facts in his own matchlessly honest and simple way; and so little did he desire notice, that for thirty-seven years he allowed this record to lie by him unpublished, till the publication of a similar series of observations by M. Taine in France stimulated him to give to the world his narrative of "A Biographical Sketch of an Infant."* Since then many observers have entered this field, with very interesting and important results. These results, which will no doubt be added to every year, when taken along with such observations as Mr Galton is making into hereditary influences and family histories, cannot fail to be of use to mankind. The bodily growth and development of human beings has been more observed than the mental. Quetelet, as far back as 1830, studied the matter most elaborately; Bowditch, in the United States, made a careful series of useful observations in 1877; while among others in this country, Beddoe, Galton, and Roberts have worked, and are working at the matter.

It may therefore be a profitable thing for us to consider this great subject of a child's growth and development for the hour you have placed at my disposal, keeping more to principles than entering into details, and having more regard to the practical than the purely scientific aspects of the question. Indeed, the subject is so vast that it does not admit of a full treatment in the space of one lecture.

PRELIMINARY CONSIDERATIONS.

Now as a preliminary we must assume certain things about our child, as laws and influences that cause and govern its development, inasmuch as it is a bit of nature and subject to the laws that govern the development of all life in nature. In the first place we must take into account the facts of hereditary likeness. Every child will be like his ancestors, pretty nearly and in a

* *Mind*, July 1877.

general way. If they were Chinese, so will he be; if they were black, so will he be; if they took long in coming to maturity, so will he; if they were strong, so will he grow; if they were long lived, so will he have a chance of living; if they were good in a natural sense, the chances are he will be so too; if they were bad, he will have to struggle hard against his fate to turn out good. Like produces like all the world over. The more minutely the subject of "heredity," as it is conveniently called, is studied the more importance it assumes in determining the development of the bodies and minds of men and women. Down even to the minutest points we are finding that this is the cardinal and underlying fact. As we shall see, it may be influenced to some extent by conditions of life, by influences from the outside, by teaching and example, by public opinion, by the codes of morality and religion to which the individual is subjected, but none of these things will so change a man's innate tendencies and potentialities that if he has had a dull brain transmitted to him it will ever become an active one, or if his father and mother have been dwarfs he will become a giant. No doubt we are yet very far from knowing in detail the laws of the hereditary transmission of mental and bodily qualities. We cannot say why a man takes after his father or after his mother, or after any of his four grandparents or after some of his eight great-grandparents (not to go further back), or what gave him the special combination of the qualities of those fourteen nearest ancestors which he possesses. But the latest and most careful observations tend to show that from the moment of birth a man is under the dominion of his ancestry, deriving benefit from their virtues and suffering for their sins in a physiological sense. The latest researches show that from the very moment of birth hereditary influences come in down to the smallest matter, influencing how the body and mind develops and when their qualities appear. The very way the infant holds his bottle, his little tricks of motion and smiling, the time at which he can make out a colour, the way he is affected by a sound, all seem to be determined, not by chance or circumstance but by ancestral influences. The diseases he will be subject to, the germs of disease he will have the power to

resist, are no doubt determined in the same way. His body, his mind, nay his morals, from the beginning are not his own in any proper sense, but belong to his ancestry. From the moment of his birth, if we were only wise enough to read his horoscope, we would see certain qualities, certain tendencies, certain potentialities, certain issues, all as fixed and definite as the course of the sun. Any particular baby does not develop by chance therefore, but it contains within its brain and its body the general directions in which alone it will go, and the capacities it will be able to exercise. Just as newly born dogs' brains can only develop dog qualities, so a child's brain can only develop ancestral qualities in the main. The latter contains within it no doubt extraordinary capacities of development in different directions, and a marvellous store of future powers, not one of which are at birth apparent even in germ. They are potentialities in short, which must evolve into actual things in time and in degree according to fixed inherent laws. The general outcome of those potentialities and laws may no doubt be greatly modified by outward influences, but they cannot be essentially altered or repressed.

It is not to be forgotten that it is one of the laws of the hereditary transmission of qualities and powers from ancestry to posterity for acquired and accidental things to be so transmitted to a limited degree. A man by hard work as he grows to manhood creates big hands for himself, and having so acquired them he transmits big hands to his posterity to some extent, big-handedness getting more sure in all his descendants in each succeeding generation if they all work hard with their hands, and don't marry small-handed women.

The next great fact we must assume as affecting the development of a child, is that the brain is the dominant organ which rules the course of progress and determines all the great lines of development. The brain may be looked on practically as the child, all the other organs and members being subservient structures. I do not mean the brain in the popular restricted sense of the organ of mind, but in the actual and true sense of its being, the source of motion, of sensibility, of nutrition, and of animal heat as well as of the mental faculties.

The next great fact we must take into account looks like a contradiction of the first: it is the susceptibility of the brain and the body to be influenced in all directions but the principal ones that are inherent and hereditary, by outward conditions, physical and mental, by food, air, climate, exercise, example, teaching, sympathy, fear, emulation, sense of duty, power of self-control, morality and religion. It is one of the great problems yet unsolved to the full extent, just how far the influence of these extends, and how much they can affect the ancestral qualities.

The next thing we must take into account, is that the body and mind of every man and woman has strict limits beyond which it cannot be developed, and that every organ and every faculty have their limits of growth too. These limits are not the same for different individuals.

The next thing of importance we need to assume as being true in the development of a child, is that each organ of the body and each faculty of the mind bears such a relationship to the whole body and the whole mind, that if the growth of any one of them is unduly great, the growth of some or all the others will be proportionally restricted. The sum of the growth and activity in any one child is so far a fixed quantity that is divided into different streams of energy, one to the muscles, another to the bones, another to the heart, another to the motive part of the brain, another to the thinking part of the brain. If one of these streams is increased beyond its due proportion, the others are apt to run small or dry. If you try to develop the mind beyond its hereditary capacity, and unhappily succeed, it can only be at the expense of some bodily function, or of the length of life that was possible to that individual.

GROWTH AND DEVELOPMENT OF THE BODY.

Let us now pass to the actual facts in the growth and development of the body of a child. I can only, of course, glance hurriedly at the most important of them. At birth the average weight of a baby among a town population is $7\frac{1}{2}$ lbs., and its height $19\frac{1}{3}$ inches, girls being less than half an inch under boys.

It is then one-sixth of the height it will attain to. At that time it is the body and head of the infant that give the chief part of the height and weight, the limbs being, compared with the adult, disproportionately small and short. Every year till full maturity the arms and legs grow more in proportion than the head and body. A child grows more in height the first year than in any future year of its life, for its average growth is then $7\frac{3}{4}$ inches. If a man grew at that rate till he was twenty, he would be $14\frac{1}{2}$ feet tall! But during the second year the rate of growth is reduced to about half of this, being a little less than 4 inches, and the rate of growth becomes gradually less till the age of twelve, when it is reduced to about $1\frac{1}{2}$ or 2 inches a year, according to the health and social position and conditions of life of the child. After puberty there is an increased rate of growth in the non-labouring classes, and it stops at nineteen or twenty, while in the artisan classes the growth is more uniform, and extends to about the twenty-third year. The average height of girls is only just below that of boys up to thirteen years of age, when she beats him for a short time both in height and weight. After thirteen he strikes out in advance of her, and leaves her 4 inches below him at full maturity.

In the four years of babyhood, from birth to four, the growth should be about $19\frac{1}{2}$ inches in height, and 36 lbs. in weight; from five to nine a child should grow on an average 2 inches a year. It should gain about 9 lbs. from four to five, between 4 and 5 lbs. from five to six years, from 2 to 4 lbs. each year from six till twelve, when his weight should be 5 stone 4 lbs. and his height 4 feet 5 inches. He should then take a start and gain from 4 to 10 lbs. each year up to fifteen years, while he should be growing in that time exactly $2\frac{1}{2}$ inches a year, after the sort of stoppage of growth between nine and twelve, when he had only grown $1\frac{3}{4}$ inches a year. After fifteen he should grow nearly 3 inches in height, and gain over 10 lbs. in weight each year up till he is seventeen, after which the rate of growth in height and weight diminishes very fast. From seventeen to eighteen he grows less than 2 inches, and gains only 6 lbs.; from eighteen to nineteen $1\frac{1}{2}$ inch only is added to his stature, and 6 lbs. to his

weight; from nineteen to twenty, $\frac{1}{4}$ inch and 4 lbs., and after that he should only gain another $\frac{1}{4}$ inch in height and other 10 lbs. in weight.

For your convenience I give the average heights and weights of 14,000 boys and men of the artizan class living in large towns, after Dr Roberts,* from whom most of my figures as to body growth and weight are taken. At five years the height was 41 inches, and the weight (including clothes) 50 lbs.; at ten, $50\frac{1}{2}$ inches, and 66 lbs; at fifteen, $60\frac{1}{2}$ inches and 94 lbs.; and at twenty, $66\frac{1}{4}$ inches and 132 lbs.

But in considering the heights, weights, and progress of growth of children from such average, or from mean nnmbers, we must remember—1st, that vast numbers of individuals differ much from the average, apart from the effects of disease; 2d, that in many individuals the usual proportion of height to weight is departed from; and 3d, that very many individual children grow not according to the rates at the different ages I have given, but at quite different rates at the different ages, and are still healthy. Nature always practises variety in her operations, from the making of a simple crystal up to the making of a man. The difference between the tallest and the shortest boys at fourteen is 20 inches. I have taken the artisan class, as showing the least you should be satisfied with in the growth of your boys and girls.

The constant things which affect the growth and development of the human body are heredity, age, sex, and race; the chief of the secondary, temporary, and controllable things are occupation, disease, social habits, nurture, food, air, exercise, and rest. We all know in a general way that an old man loses height, but the scientific observations of Quetelet show that he begins to recede at fifty, and by the time he is ninety he has lost $1\frac{1}{2}$ inch. The height woman attains is less than that of man, for three different reasons—1st, the woman is born a little smaller—about half an inch, as we have seen; 2d, she grows less each year after fourteen; and 3rd, her growth ends two years before that of man. Girls

* Roberts' *Manual of Anthropometry*.

have a spurt of rapid growth from eleven and a half to fifteen; in boys the same spurt only begins about twelve and a half or thirteen.

We all know in a general way that some races are bigger than others. We don't as yet know the fact from accurate statistics, but it is probable that this difference of size exists at birth. There is little doubt that a dozen Scotch babies would weigh far more than a dozen Chinese babies. And taking the races of which our own country is composed, Dr Beddoe has shown that early in boyhood the Teuton is bigger than the Celt, the Scotchman than the Englishman and the Irishman; while Dr Bowditch showed that native New England American boys grow faster than the children of the emigrants into the country.

It is proved beyond a doubt that social habits, food, and modes of life exercise a great influence on the rate of growth of children. Boys of the richer classes at the public schools in this country are on an average $3\frac{1}{2}$ inches taller and 10 lbs. heavier at twelve years of age than the sons of the industrial classes who have sedentary trades, such as shoemakers, tailors, or factory operatives. Comparing country and town simply, we find that the country has it in height and weight all along the line during boyhood and manhood.

Looking at the development of the different parts of the body, we find that they have a different relationship to each other, both as regards shape and size, at different ages. Taking first the legs, they are at birth very small, their average length being only $6\frac{1}{6}$ inches. They grow to five times that length, or $31\frac{1}{2}$ inches, at maturity. While the head and neck only double themselves from birth to maturity, the trunk increases to three times its length, and the arms to four times their length. But that growth is not uniform in any of the divisions of a limb. The thigh is that part of the body which increases at the greatest rate of any other portion, for this portion of the leg attains at maturity seven times its length at birth. It is the length of the thigh that determines to a greater extent than any other portion of the body the total height: about most tall persons we might truly say, not that they are a very great height, but that their

thighs are very long. Most likely their heads and bodies, and legs below the thighs are not very different from their shorter fellow-creatures. The arm doubles itself in length in the first four or five years. The trunk is the part that grows most regularly and equally in length and girth. In estimating the growth of a child, the chest girth is of great importance to note, for that shows roughly the breathing capacity. The average empty chest girth of newly-born children is $13\frac{1}{4}$ inches. It should have increased to $21\frac{1}{2}$ at five years of age, to 24 inches at ten, to $27\frac{1}{2}$ at fifteen, and to 31 inches at twenty, those numbers after birth (when all classes are about the same) applying to the artisan class in towns. From 2 to 4 inches must be added to those numbers for country boys or the sons of the richer classes.

The head is more completely developed at birth than any other part of the body. In the child it should be one-fourth, and in the adult it should be one-seventh part of the whole height in the average man and woman; but it is one-ninth in the case of giants, and one-fourth in the case of dwarfs. The foot is the part that from birth to maturity bears in length the same proportion to the whole height of the body. In the male sex the whole height should be $6\frac{3}{4}$ times the length of the foot; in the female sex, $6\frac{1}{4}$ times. At ten years of age the length of the foot should be exactly the height of the head.

Looking at the structure of the tissues and organs of the baby, we find they differ in many respects from that of the mature man or woman. Speaking generally, they are much more soft and unformed. The bones are each divided into many parts, and are largely composed of cartilage or gristle. They gradually harden until they become solid bone throughout at maturity. If they don't do so, we have them unfit to support the weight of the body, and they twist and bend as in the disease we call rickets. Being the platform on which the other tissues are raised, and forming the protecting case of the brain and internal organs, it is very important to have the bones grow and harden uniformly and fully. Yet they should not harden and unite in their different parts too soon. When that takes place among the bones of the skull the brain becomes cramped, cannot expand, and we have one variety of idiocy resulting.

The composition and structure of the muscles, of the internal organs, and of the blood are in some respects different in childhood from maturity. In all of these there is a gradual process of change and development as well as of growth after birth, which, if interfered with from disease or bad conditions of life, we have many evil results, so that fully developed and matured manhood and womanhood are not attained, and the bodily life of the individual is shortened, and his happiness interfered with, as well as the prospects of future generations marred.

GROWTH AND DEVELOPMENT OF THE BRAIN.

As we have seen, the brain is the dominant organ of the body from the moment of birth up to the time of death. We cannot study or understand in any way the growth or development of the body without reference to the brain, and above all we cannot study the mental development except through the brain. Granting that the infant has a mind apart from its body, yet it is quite certain if he could not see, or hear, or feel, or speak, his mind might grow, and we should have no knowledge whatever of the fact. But his mind would not grow in these circumstances. We must go to the mind apparatus, its organ, its originator, and revealer to us—the brain—when we want to study the mental development of a child. Where there is no brain there is no mind. Where the brain grows rightly, the mind develops naturally. Where the brain ceases to grow, the mind also ceases to develop, and we have idiocy resulting. If any of the organs of sense, such as the eye or ear, or their centres in the brain, are absent at birth, we cannot have full mental development. If a child is blind from birth, he cannot have the mental power of comparing one colour with another, and the whole of the ideas connected with colour are absent. You convey no idea to such a child by saying, "How nice the cool green of the grass is compared with the whiteness of the road," or by speaking of the "Red Republicans of 1790."

I am not going to describe the mechanism of the brain, but I must here refer to it as consisting of—1st. A receptive, regula-

tive and productive portion which appears to the naked eye as the convolutions (see fig. 1 C), and through the microscope when

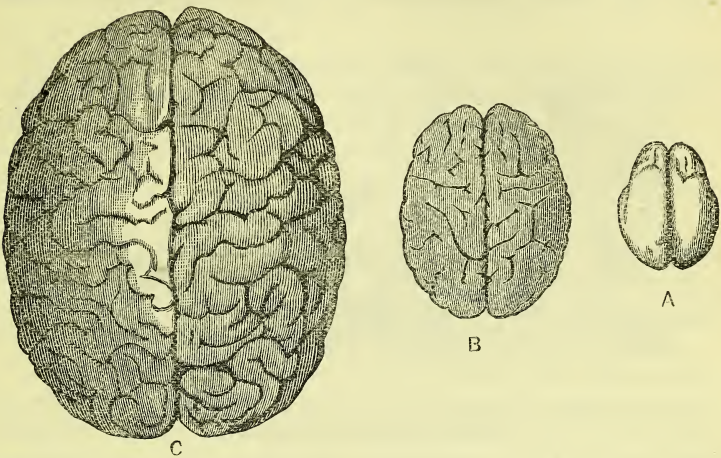

Fig. 1. The brain at different ages, showing its size and the development of its convolutions. A. Three months before birth. B. At birth. C. At full maturity in an educated man of great mental capacity. Those are drawn to the same scale from nature.

very highly magnified as a vast aggregation of twelve hundred millions of minute cells (fig. 2), each one of which acts by itself and also in combination with other cells in groups (see fig. 4), large and small. There are 1,200,000,000 of these cells. It is through the perfect action of these cells when fully developed, and of these groups of cells when properly grouped and associated with each other, that we have impressions properly received from the senses, and when received producing their proper feelings and ideas, and it is through them that we are able to send out energy to stimulate the muscles to move as we will. In fact, it is through these cells, their groupings and their activity, that we think and feel and move. A brain cell of the larger kind is a complicated and highly organised structure (see fig. 2), like an electric battery and telephone in one, with many processes projecting from it. The impressions from the outside would, through touch and the organs of sense, reach the cells through these processes just as the voice of the speaker at one end of a telephone

reaches the ear of the listener at the other end of it, by means of the current of electricity through the electric wire.

2. The second great portion of the brain consists of nerve

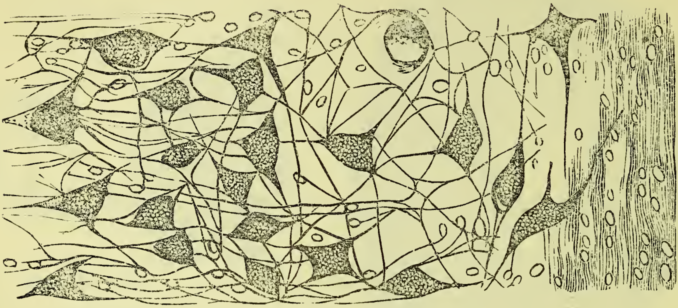

Fig. 2. Brain cells from the convolutions at full maturity, showing their forms, processes connections, and their network of fibres.

fibres (see fig. 4) or conducting rods, which convey the messages of the cells outwards, or conduct the messages of the outside world to them. It is estimated that there are 4,800,000,000 of such

Fig. 3. Brain cells in their earliest and simplest stages before birth, before they have developed or connected themselves by processes, or formed themselves into groups.

fibres in the brain. Those numbers of cells and fibres in the fully developed brain are to us simply inconceivable, but the

statement of their number enables us in some degree to imagine the apparatus through which the infinite number of sensations, acquisitions, ideas, feelings, and remembrances of an adult educated man are possible.

The brain, three months before birth, is a very simple organ indeed, with almost no convolutions or foldings (fig. 1, A) at all, and at birth (fig. 1, B) its structure is still simple compared to the adult brain (fig. 1, C), and its size small. In a general way the power of a brain is determined by the number and complexity of its convolutions. The average weight of the brain at birth is 13.8 oz., while at maturity it is $49\frac{1}{2}$ oz. The woodcuts A, B, and C, being reduced to the same scale from nature, give an idea of the relative sizes of the organ three months before birth, at birth, and at maturity.

It is in the intimate structure of the brain that this contrast between it in the early stages and at maturity comes out most strongly. As seen in Fig. 3, the brain cells in their very earliest

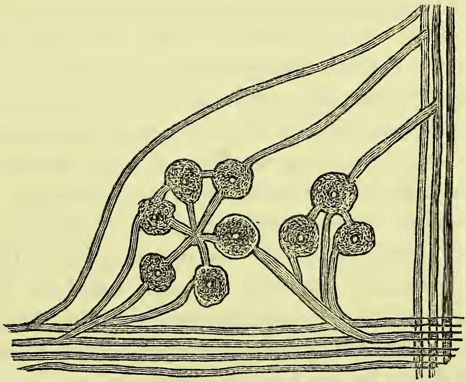

Fig. 4. A diagramatic representation of how brain cells associate themselves into specia groups, the cells in each group being specially connected with every other cell in it, and then the whole group with the general nervous system, through the fibres that pass in different directions.

condition are a mere series of simple bodies, with no connections or attached processes, and no special groupings, just like the cells composing the skin or the fat. The difference between this condition and that represented in Fig. 2, is very great

indeed, as regards development and capacity for high function. At maturity a bit of a convolution of the brain is the highest development of structure yet known in nature, and possesses by far the highest functions. It is so complicated and delicate, that it has yet defied the most skilful microscopists fully to unravel its structure. A section through it looks as confused as a section through a herring net might be, if you squeezed a portion of it up into a ball, dipped it in glue, allowed it to set, and then cut a slice through it. In its early stages it is so simple that a section through it more resembles a slice through an orange, where the divisions and seeds are seen at once to be symmetrical, and their arrangement simple. Now, this difference in structure is represented by a corresponding development in work, or capacity for work. At birth, the brain is like a simple telegraphic system in a small town, that brings the post-office, the merchant, the squire, and the doctor into communication with each other. At maturity, the brain is like a large city, with thousands of interlacing telegraphic wires, hundreds of batteries and telephones, by means of which thousands of men can instantly know each others' wishes, and be brought into communication with each other. The process of growth and development of the brain from birth to maturity, is like the gradual creation of such a telegraphic and telephonic system as now exists in our large cities, through which their business is largely done. The analogy fails at one point utterly, and that is in conveying an adequate idea of the complication of the nerve apparatus in the fully matured and educated brain. All the hundred thousand telegraph wires and batteries and telephones in all London, are a simple and intelligible system compared to the nervous apparatus of cells and fibres in one human brain.

The brain develops in a child by the multiplication of the cells and their processes and fibres, by the multiplication of the groupings of the cells, and by different groups being brought more and more into association with each other. The number of groups and associations of groups that can be made out of 1,200,000,000 cells, no mathematician could calculate, and no one can imagine. As Bain puts it: Suppose any human being has 50,000 mental acquisi-

tions of knowledge, there would be for each of these 20,000 cells and 100,000 fibres. With a total of 200,000 acquisitions, which would certainly include the most retentive and most richly endowed minds, there would be for each nervous grouping 5000 cells and 25,000 fibres. Brain development from birth consists in the perfecting of the apparatus for mental acquisition, and for corresponding mental expenditure.

To develop anything great and complicated in nature to perfection needs favourable conditions, and is always liable to many interferences. In fact, the risks are in proportion to the complication of the thing to be created. A simple lichen will grow on a bare rock exposed to any blast, while a delicate fruit tree needs soil and shelter, sunshine, and incessant care. The one runs no risk of arrest half-way, the other's life is full of risks, of death, of barrenness. We shall see by-and-bye the risks which the human brain runs in its development.

THE MENTAL DEVELOPMENT.

It may sound strange to some of you, but at birth a child is absolutely destitute of mental faculty. The thing does not exist. All competent observers agree on this point; and all newly born children are equally mindless. There is no exception. But why does the child cry, and seem to feel pain, and move, and feed himself? Those, at first, are all automatic or reflex actions unaccompanied by mind, the apparatus for performing which in the brain and spinal cord, is almost perfect at that time, while the mental apparatus is undeveloped. He breathes, too, as well as ever he will do, just because the group of nerve cells in the brain that produce and regulate the breathing movements is perfect at birth. He does not even see, as you can prove by holding a lighted candle before his eyes and moving it. He takes no notice of it, and he will not follow its movement with his eyes at all. About the ninth day he will stare at a candle, but it takes six or seven months before a child will follow an object with his eyes as if he really saw it. From the beginning he will start and cry at sounds, but that is automatic. It takes six months before he will give any

indication that he knows from what direction sounds proceed. He will grasp your finger if you tickle his palm at birth, but this is automatic. It takes him three months before he can first grasp anything voluntarily, and then with a co-ordinated movement puts it to his mouth. The movements of a child are, at first, vague and purposeless ; but when he finds that certain combined movements, such as putting things to his mouth, which at first he made accidentally, give him pleasure, he repeats them voluntarily again and again with more precision by practice till they are done with certainty. The apparatus for combining simple movements lies in the brain at first in a rudimentary form, but it is ready for development, and these movements, no doubt, help to develop the combinations of brain cells into groups, and to associate different groups with each other, while the pleasure the movements give, and their results, help to associate certain ideas with the movements each time they are repeated.

There is no doubt at all that the two first mental states that are developed in a child, the primary affections which precede all others, are a feeling of discomfort or ill-being when bodily or external conditions are out of harmony with his existence, and a feeling of well-being when they are favourable to him. Those feelings in some form exist no doubt in the lowest of the animal creation. In about three months it is evident that the exercise of his own powers of motion, when he tosses his arms and legs about, give him pleasure, and ever after during development, muscular exercise and pleasure go together. Hence motion is constantly practised. The sensation of pleasure is chiefly produced at first from without by the taking of food, and if the same person always gives it the pleasure is connected with an external cause, and so the feeling of attachment and love is first begun. A child first begins in a faint way to smile when he is about forty-five days old, and this is the first muscular expression of pleasure. Smiling commonly seems to arise in children at first from looking at their mothers. The sense of humour as evinced by smiling at anything of the nature of play, is not shown till about the age of three months. Pleasant surprise seems always to be the cause of the first sign of amuse-

ment. This capacity of humour and amusement becomes very strong in healthy children in a short time, and helps to make them play, and this again tends to develop their muscles, to keep their blood in active circulation, to increase their appetite, and so promote their bodily growth.

The development of speech, and the ways in which sounds and names are gradually associated with persons and things, and then with ideas, is one of the most interesting processes in a child's mental development. M. Taine studied this process carefully in his child. Of course a child can cry and make a noise from the moment of birth, but its language for long is "but a cry." The child first makes vowel sounds only. At three months many such sounds are made, and he goes on making sounds that have no apparent meaning to him. He is trying his vocal organs in a vague way, just like the purposeless though constant movements of his arms and legs. He must first learn to use his voice and make many sounds, and then he is able to select some out of these as a simple vocabulary for himself. Consonants are by degrees added to vowel sounds, and the exclamations become more and more articulate. Taine says the sounds (both vowels and consonants) "at first vague and difficult to catch, approached more and more nearly to those that we pronounce, and the series of simple cries came almost to resemble a foreign language that we could not understand. She takes delight in her twitter like a bird. She seems to smile with joy over it, but as yet it is only the twittering of a bird, for she attaches no meaning to the sounds she utters. She has learned only the materials of language at twelve months." As a child makes new sounds they amuse him, and he repeats them again and again. Education is at first only of use in calling attention to certain sounds that have already been found out and getting a meaning attached to them. All children say *papa* and *mamma* long before they attach any meaning to these words. It is certain the initiative for all this is in the brain. Imitation and curiosity are the great educative faculties of young children. From the fifth or sixth month children employ their whole time in making physical experiments. No animal shows the same interest in its own movements and sounds,

and in all things within its reach. At twelve months, all day long the child makes sounds, touches, feels, turns round, lets drop, tastes, and experiments upon everything he gets hold of, whatever it may be, ball, doll, coral, or plaything. When once it is sufficiently known it is thrown aside, there being nothing further to learn about it. Children attach meaning to the words heard before they can utter such words themselves, or before they attach meaning to the words they utter themselves. At first children make one word or sound cover a number of things. "*Bow-wow*" when first associated with a dog, usually means to the child not only all dogs, but all animals on four legs. Taine's little girl after having a picture of the infant Jesus pointed out to her repeatedly and called "baby," made that word stand for all pictures in bright shining frames, the frame in her mind being evidently the thing with which she associated the sound. The first few words she learned were attributive words or the names of things. Soon she invented a word, *tem*, which at first seemed to have no meaning for her; but she repeated it often and soon used it to express all the three ideas of *give*, *take*, and *look*. It was used to express a wish for anything, to direct attention to anything, and to order any object to be brought to her. This was a great advance in mental development over the mere knowing an object by a name. A dog could have done that, but a dog could not have used a sound to express this little girl's *tem*, nor have been made to understand the ideas it expressed in her case. The use of it at fifteen months old, marked the stage at which the human brain and mind proved itself superior to those of the most intelligent of the lower animals. After this she invented many such words for herself to express her own meaning, such as *ham* (eat, I want to eat). This power of inventing words to express meanings shows almost certainly that if two children were brought up by dumb parents and heard no speech, they would invent a language for themselves. The faculty of language is in their brains and would, as their brains develop, show itself independently of any imitation or teaching of any known speech. In fact, if a child's language is carefully studied from the first to the second year, we find that it has used several simple vocabu-

laries to express the same things at different stages of its speech-growth, and also that many meanings in succession are given to the same word; these meanings gradually becoming more specific and less general as its knowledge increases. Thus "*bow*" may be used to mean, to the child, all animals; then to mean any dog; and last of all to mean the special dog the child sees every day; and bye-and-bye it is discarded altogether for the real name of the dog when that can be pronounced. The same process essentially can be seen to have taken place in primitive peoples through a study of their languages. The aboriginal Australian has no words to distinguish darkness from a black colour.

Darwin tried to fix when and how the various mental feelings and powers arose. Fear is one of the first feelings that can be made out to arise in an infant. When a few weeks old he will begin to show signs of this by starting at any sudden sound, followed by crying. It is well known how older children suffer from vague and undefined fears from the dark, from passing obscure corners, &c. Darwin thinks such undefined but real feelings of dread are the inherited effects of the real dangers and abject superstitions of our savage ancestry transmitted to us.

Anger is exhibited after ten weeks, while violent passion is seen at four months by the flushed face and contorted features. Boys will bye-and-bye show their anger by throwing things at those who offend them; girls will show it by screaming and tearing at their clothes, showing how such things are inherited, and how soon such hereditary qualities are exhibited.

As to affection, it is very early shown, but there is no evidence that an infant can distinguish one person from another till it is four months old, notwithstanding the strong and delightful beliefs of all young mothers that their babies know them whenever they open their eyes. Sympathy is shown at six months old by a child's crying when its nurse cries. Jealousy is first seen about fifteen months of age.

So much for the simpler emotions. When does reason appear? Darwin says he observed the first proof of reasoning power on the 114th day in one of his children, when, "after grasping my finger and drawing it to his mouth, his own hand prevented

him from sucking it," and he showed his "practical reasoning" by "slipping his hand down my finger so as to get the end of it into his mouth." When $4\frac{1}{2}$ months old he smiled at his image in the mirror, mistaking it for a real object; but in less than two months more he perfectly understood that it was an image, for if he was looking at his father's image and it grimaced, the child turned round and looked at the father. This could only have been done by a reasoning process. But he applied the same process when he saw his father through a plate glass window, for he looked behind him to see his real father, thinking it was another mirror and another image. Many associated ideas became fixed in his mind at five months, *e.g.*, going out, with putting on his hat, and at seven months he made the great stride of associating the nurse with her name. As Darwin remarks, What a contrast does the mind of an infant present to that of the pike, who during three whole months dashed and stunned himself against a glass partition, which separated him from some minnows, and when at last, after learning that he could not attack them with impunity, he was placed in the aquarium with these same minnows, then in a persistent and senseless manner he nearly starved himself by not attempting to eat them up.

The first sign of conscience, or a knowledge of right and wrong, was noticed by Darwin at the age of thirteen months, when his boy was made to look and feel unhappy by being accused of not giving his papa a kiss. A certain tendency to deceitfulness, and to do furtively what they have been told not to do and know to be wrong, is natural to most children, but it is developed in some to an enormously greater extent, and much sooner than in others. The children of the habitual criminal classes are said on all hands to take to deceit as a duck takes to water. The children of gipsies are restless, fawn, and lie just as naturally as their ancestors roved about and earned money by pretending to tell fortunes. The feeling of right and wrong can be strengthened greatly by proper means during the mental development. No doubt those means should be directed towards cultivating a love for the good, and a hatred and scorn for the evil, rather than towards merely causing a fear of bad consequences if the evil is

followed. In too sensitive children moral lessons can be too sedulously taught at too early an age, for I have seen by that means an artificial and false conscience created, so that right and wrong were seen in actions that had no moral meaning. I have seen a child of six brought to that pitch of unnatural morality that it felt acutely it was very wrong to eat too much jam to tea, cried, and was unhappy in consequence, and seriously contemplated the possibility of going to hell if it died that night. Any attempt to forestall nature in creating a conscience in a child is apt to be followed by a deadening of the sense of right and wrong in after life. The *knowing* of right from wrong should always in a child's mind be associated with the *doing* the one and avoiding the other, and the doing right should always be associated with those inward feelings of pleasure that well-doing should produce. Darwin says he educated his child in morals solely by working on his good feelings, and he soon became as truthful, open, and tender as anyone could desire, though at $2\frac{1}{2}$ he had shown "carefully planned deceit."

There are certain parts of the brain called the inhibitory or controlling portions which regulate the motions of the heart, of the lungs, and the nutrition of the body, as well as regulate and control the functions of other parts of the brain. They are higher parts that control the lower. It is of the greatest importance that those controlling portions are properly developed, just as it is of the highest importance that the great mental power of "self-control" should be properly developed. Some children will always, if untaught, allow their impulses and desires to run away with them, and will make no attempt to control their eating, or their play, or their desires to annoy or hurt their fellows. There is no doubt that the children of habitual drunkards and insane parents are apt to show this lack of the self-controlling faculty. It requires much careful study of each child's natural tendencies and inherited weaknesses to be able to guide its mental development rightly in this most important matter of self-control, but of all the lessons a child can learn, this is the most important.

The last power in a child, of which I shall speak in regard to its

development, is the general force of volition, or will-power to act and energize as an independent being, strongly and persistently. This, in a good brain, developes very rapidly after the first year, till past maturity. It is this which gives one man "force of character," as compared with another; that enables one man to persist in any course he has marked out for himself regardless of obstacles. It is this quality which makes one man great, as compared with another. All men must have it in some degree. It is most difficult to know how much a strong and persistent will should be repressed in a growing child, and how much it should be strengthened. There is a horrible expression one hears sometimes, that of "breaking a child's will." If it were possible to do such a thing, it would be the greatest injury that could be inflicted on any human being. It would be depriving him of his very highest faculty. Depend upon it, the stronger our children's wills are the better, so long as things go in the right direction. The best thing we can do is to develop the will-power of our children as much as possible, and to direct it aright. The more individuality and force of character they have the better.

There are certain faculties which are much stronger in children than in grown up people. Those are notably curiosity, imitation, keen desires, and a striving to make those about them laugh.

From birth, when the brain weighs about 14 oz., up to two years, when it has attained twice and a half that weight, there has been a series of new evolutions or creations of new faculties. After that there takes place a gradual perfecting of those faculties. From two years up to fourteen, the brain gains in weight from 34 up to 45 ounces, and the mental faculties and bodily powers should all be growing, developing, strengthening, and gaining in power, the memory laying up stores of acquired experience, the educability and imitation enabling the child to advance in some direction from everything it sees and hears. The comparing and judging power is ever strengthening and moulding the crude impressions and acquisitions into truer and more real knowledge.

The capacity of a child to take up any properly religious ideas comes later than its moral sense. Except in so far as religion is connected with right and wrong in action, its ideas are too abstract for an average child of two to understand them. It is doubtful if before the age of five, any sort of true idea of a Deity or a Creator can be acquired in most children. Looked at from the purely psychological point of view, those vague undefined fears to which I alluded are the foundation of the religious instinct. I need scarcely say to any rational man or woman how carefully we ought to develop those superstitious feelings of vague dread into something more elevating and ennobling, more rational and duty-inspiring.

As to the question of the period in the development of a child when he should go to school, I think it depends much on the sort of school he goes to, and the kind of child he is. Probably six would be the most suitable age to begin a systematic school education, from a medical point of a view of an average child's development.

I had intended to give a sort of analysis of a child's mental condition and powers at five and at ten years of age respectively, and of that of a youth at fifteen, comparing them with full maturity; but I have been so diffuse in saying what I have said, that I have left no time for myself to do this. The gradual development of the masculine and feminine special mental characteristics is also a subject of much interest that I must pass by.

SOME PRACTICAL CONSIDERATIONS CONNECTED WITH THE SUBJECT.

As this is a Health Lecture, I shall conclude by endeavouring to give some practical hints that may be useful to those who have the duty of supervising the growth and development of children, and who have the responsibility of endeavouring to attain the best result that is possible.

1. We should endeavour to find out the inherited peculiarities of mind and body of our children, so that during their growth and development weak points may be strengthened and strong

points may not be misunderstood. I am satisfied that we can't begin too early to do this. While evil tendencies of body or mind are "potentialities," as we say, or mere tendencies, something may be done to modify them ; after they have become actual tangible things it is usually too late. If consumption, or convulsions, or rheumatism, or insanity, or heart disease, or lack of self-control, or immorality, or drunkenness have been strongly in the family, it is mere folly to think they may never appear in the children, and to neglect measures that during early life might help to correct those evil tendencies. It is better to look ahead in regard to these things. What better use can we make of our reason than this!

2. We should endeavour to promote proportionate development of all the faculties and powers bodily and mental, not attending to one set unduly in early life. In this we merely follow nature's lines. She resents forcing-house treatment of any faculty or power too early in life by dwarfing others. We should lay a good foundation for future special work, if that should be required, by promoting at first a sound mind in a sound body, that is well proportioned and stable mental and moral faculties in a healthy and vigorous frame.

3. Certain physical conditions are absolutely necessary to the proper growth and development of a child. Food should be abundant and simple. Milk, bread, butter, eggs, potatoes, vegetables, and Scotch broth are the very best of all foods for children, and they should be given in abundance, and often. Ask any stockbreeder how he feeds his calves when he wants to make them into prize cattle, and he will tell you that he saturates them with milk and lets them stand knee deep in rich grass all their babyhood. Flesh is neither necessary nor good for them in any but small quantity. Flesh-eating children are often nervous and thin, both of which are contrary to nature's type of child. Fresh air in abundance is absolutely necessary during development. The Queen's Park and the Meadows should save hundreds of children's lives in Edinburgh were they used as much as they should be.

Exercise and play are nature's best aids to proper develop-

ment. Play in a child means health, and makes health. Sleep in abundance is most necessary during development. In my opinion, a child can't sleep too long, especially one brought up in a city. But the minimum of sleep should be 12 hours a day up to four years, 11 hours from that to 7 years, 10½ from 7 to 10, 10 hours from that to 15, and 9 up to 20 years of age.

4. As we watch and guide children's development, we should never forget that great faculty of theirs, imitation, in which they exceed us by far. Nature develops it early in them as the chief means of their education. Let us show them a good example, therefore, above all things.

5. We should weigh, measure, observe, and take stock of our growing children at regular intervals. It is a simple and most interesting process, and exceedingly important. I weigh my children the first Sunday in every month, and measure them every quarter. In that way we can often find out and stop the beginnings of evil.

SOME OF THE SPECIAL RISKS TO A CHILD DURING ITS GROWTH AND DEVELOPMENT.

1. The greatest of these are disease and death. During the first year of life, over one-fourth of all the deaths of this country take place, and very nearly one-half of all the deaths are those of children under five, or, to put it another way, one child in every six who are born dies in the first year of life, and one in every four within the first five years. If our care of them was what it should be, the little ones should not die at that rate. This is proved by the fact that while in Liverpool one child dies in its first year to every four and a half who are born, in the rural healthy county of Westmoreland only one dies to every nine and a half who are born. If the children throughout England had as good a chance of life as they have in Westmoreland, over 45,000 babies' lives would be spared. It is satisfactory that in Edinburgh we stand fairly well in this respect for a large city. The infants die with us at a less rate (127½ per 1000 births) than in any large English town, and we are considerably under all England,

town and county together (151 per 1000), in this respect. Nearly all the infectious and contagious diseases attack young children much more readily than grown people, and they are all then very fatal within the first year of life. No commentary that I can make would accentuate these figures. It is bad to be poor and to have to live in crowded streets, but the little children suffer above all.

2. If the development of the brain is arrested by disease or from any other cause, we have the condition of idiocy or mental imbecility resulting. One in every 700 of our population is in this condition, their number being over 30,000 in Great Britain.

3, Bad constitutions with the seeds of disease in them, unfit to stand the strain of life, or to do its work well, are commonly enough the result of improper or imperfect growth and development. The people whose lives are not worth having, frequently owe it to defects of care in their early years.

4. Wasted lives from mental and moral causes frequently have their origin in bad conditions of development. Lack of self-control is not surprising at maturity when the controlling faculty has not been developed in youth.

5. Over-development of faculty by unnatural forcing before the brain structure is developed is an unsafe proceeding, and may defeat its end entirely.

6. Lack of development and culture of the faculties from want of training and education leaves them useless, and the life stunted and unproductive in consequence.

In conclusion, let us not forget the truism that our children have their lives to live only once over, and if we can help them to make the best of their lives, they will assuredly in their maturity "arise up and call us blessed."

PHYSICAL EXERCISE; ITS USE AND ABUSE.

By CHARLES W. CATHCART, M.B., F.R.C.S.

Ladies and Gentlemen,—When I had the honour of addressing this Society last year on the subject of Physical Exercise, a wish was expressed at the close of the lecture that I should continue the subject in the series of Health Lectures for the present winter. I need not say that I felt honoured by the proposal, and having willingly acceded to it, I am here to-night to carry out your request to the best of my ability.

It was necessary last year to begin the subject under consideration from the beginning, and to understand precisely what physical exercise means, and what processes it really involves. We saw how important a place it holds in the economy of our frames, how it causes the bones to grow and the muscles to enlarge, how it quickens circulation, increases respiration, widens the chest, purifies the blood, and increases the tone and vigour of the whole system. In a word, I hope I succeeded in showing you that "physical exercise is of the greatest importance to mankind throughout life, and in young and growing people its value is simply beyond calculation." Working on now from this standpoint to the consideration of the actual applications of physical exercise to everyday life, we find ourselves face to face with a problem which is both difficult in its exact solution, and somewhat extensive in its bearings. The agent is undoubtedly a valuable one, but how we may use it to the best advantage at different ages and in the various conditions of life is a question which it is not so easy to settle. Accordingly it was with no little hesitation that I began the consideration of this branch of our subject. Not only was it difficult to select out of much that

might have been discussed, those special parts which it would be most advisable to consider, but when any part had been chosen, it seemed difficult to obtain evidence on it, to lay before you, which would be authentic and reliable. There seemed, however, to be one subject more under discussion than any other, and which we might therefore assume to be the more deserving of consideration, especially too since it seemed possible to obtain some reliable information about it. This was "the relation of school games to accidents," and so I resolved to make it the text or centre of my remarks to-night, leaving myself free to discuss any other bearings of the "use and abuse of physical exercise," as occasion and opportunity might suggest.

In some form or other we hear it constantly asked—"Is football not too dangerous?" "Does it need to be so rough?" "Can nothing be done to make it milder?" "Are athletics not overdone now-a-days?" These and similar questions must be familiar to most of us who have taken an interest in the subject, and so I thought it might be doing some service to the Society if I could in any way contribute to the solution of this important problem. In thinking over how we might best approach this subject, it occurred to me that the most natural source of information to appeal to would be the head-masters of the various schools throughout the country. These men being in constant charge of boys make it a duty to consider everything that may be for their welfare, and are therefore perhaps of all others the most justly entitled to be heard on such a subject as the present. With the object, then, of eliciting the views of these authorities (and of the school doctors where possible), and of thus being able to lay before you information that might be both interesting and fresh, I adopted the following plan. With the help of my friend, the Rev. Charles Darnell of Cargilfield, I drew up a series of questions which were sent to the various public and private schools throughout England and Scotland. The objects in view in framing the questions were to discover—(1) if the accidents at athletic exercises were really so serious as is often said to be the case; (2) if it were possible to avoid any of the supposed risks by making alterations in the method of carrying out the exercises and games; (3) if it were not true that boys left

to themselves without organised games were in greater danger of serious accidents than would be found to result from the game, even were all the worst fears realised; (4) whether there was not good ground for believing that the exercises and games as at present carried on did not exercise a beneficial effect on even admittedly delicate lads; (5) to discover if possible what class of delicate boys were benefited and what class were injured by being allowed to compete in athletic exercises; (6) and lastly, to call forth the opinion of the head-master or school physician on any other point that he might think of importance in relation to the subject. You will perhaps be able to follow me better if I tell you precisely what the questions themselves were. The schedule headed "Athletic Exercises and School Games" left space for the name of the school, the average number of boys, and the period over which the observations were carried.

Question I. ran—"Have any serious accidents happened in the last years?" and in order to classify them space was left under the heads of "Fractures," "Dislocations and Sprains," and "Other Injuries," for accidents at the following:—"Football," "Cricket," "Athletic Sports," "Rowing," "Lawn Tennis," "Gymnastics, Single Stick, &c."; and "While Skylarking or Playing at no Organised Game." At the end of each there was room for the total and the number of boys playing in each, while below space was left for any remarks or notes that might be thought necessary.

II. If unable to give exact figures, can you say—(1) If any serious accidents have happened? (2) If they seem to you to have been more numerous in some games than in others, in proportion to the time occupied and the number engaged, or when no organised game was being played?

III. Is it your opinion that the athletic games and exercises as at present carried out involve such serious risk to life or limb as to call for or justify their modification?

IV. If so, can you suggest any such change in the carrying on of these sports or games as would lessen the risk?

V. Have you observed any evil consequences from chills or colds taken at or after games? or, on the other hand, from being spectators at games?

VI. Have you observed any evil consequences from these games not included in the above questions?

VII. Have you observed any change in the health of previously delicate boys which may be fairly attributed to athletic games or exercises?

VIII. Can you classify the admittedly delicate boys who have come under your notice as (1) those beneficially, (2) those injuriously affected by the exercises and games in question?

IX. Have you ever observed any immunity from epidemics among the boys who are specially engaged in athletic exercises?

X. Is there any other point which you think it important to mention in relation to this subject?

After each question a space for the answer was left, and with each schedule a printed letter was enclosed explaining the reasons for making the enquiry.

About eighty of these were sent out in all, and I have received altogether nearly forty replies. Some were merely to state that being day schools no returns could be given. Thirty gave answers more or less complete to the questions asked in the schedule, and a large number not only filled up the schedules, but sent me long letters besides. In one or two cases of the largest schools the medical attendants sent me in addition their opinion in the form of a short report. It was one of the stipulations of my letter that no names should be published, but I may, however, be allowed to say that among those who have answered are included the chief public and private schools in England and Scotland, and I should like to take this opportunity of thanking very heartily, although only in a general way, those who have so kindly aided me in this enquiry.

What I propose to do is to give you the chief replies to each of these questions, taken one by one, and then after indicating the general conclusions to which they point, to introduce any other aspects of the question which may seem to be of importance.

Statistics are proverbially untrustworthy, and I have no reason to ask you to believe that mine should be any exception to the rule. However, such as they are I lay them before you as the reply to our first question.

If we take football, which is without exception allowed to be the most productive of accidents, I find that altogether the records of 46 fractures (chiefly of the collar bone), 93 dislocations and sprains (some severe, some very trifling) and 23 other injuries are given to me. These have taken place among a total number of 3540 boys, in periods varying from 2 to 30 years. Reducing the original figures to single injuries per annum, we find that there would be one fracture among 760 players each year, and similarly one dislocation or sprain among 373, and one other injury among 1175 players. Putting all altogether there would be one recorded injury at football per annum or football season among 206 players. These certainly do not seem very serious. Allowing, however, for a given proportion of accidents to have escaped the memories of those who have recorded them, we may contrast with them the accidents given under the head of "Skylarking," for a similar period at the same schools, bearing in mind that the chances of omissions are the same in both cases. The numbers respectively are 15 fractures, 47 sprains or dislocations, and 13 other injuries. These if reduced in the same way per annum give us one fracture among 2611, one dislocation or sprain among 1958, and one other injury among 2136 boys, or altogether one recorded injury while sky-larking among 740 boys each year. This, of course, is a considerable difference, but although it would be further increased if we considered that the latter extend over the whole school term, while football lasts only for four months, we must remember that one great purpose and function of football and other systematic exercises is to keep the boys from the inclination and opportunities for the risks of skylarking. If so many accidents happen when irregular play is kept down to a minimum, what would it be if boys were left to amuse themselves as they liked?

We need not calculate the accidents under the other headings, because altogether they do not amount to so many as from "skylarking."

It would be unwise for us to base any conclusions on the numbers which I have just given to you; they are only intended to be indications, but it will be of interest to compare the results thus obtained from schools in different parts of the country,

with the general impressions of their various head-masters and school-doctors. These are, of course, all given as the result of individual experience, and without any of these writers being aware of the opinions expressed by the others.

Let me quote a few of the answers to Question II. From the head-master of a school of 300 comes: "Football is unquestionably the most dangerous school amusement, but the percentage of accidents with us is extremely small." A medical attendant says: "My experience extending over a period of upwards of thirty years, in a school of about, on an average, 600 boys and adults, shows conclusively, that while accidents are inevitable in so large a community living within a limited space, yet that the thorough regulation and enforcement of proper exercise tends to give security against some of the more severe forms of accident. During one period of the history of the school, when games and athletic exercise were under no kind of efficient regulation, serious accidents were of no rare occurrence." Again: "Of all games football exposes the player to the greatest risk of injury; the more rapid movement and closer contact of the bodies of the players in this game, of necessity increases the chance of injury. . . . . The gravity of injuries is greater in this than in any other game or sport." In a P.S. he adds: "Since the year 1849 none of the accidents that have happened in the school games have proved to be of life-long injury. Two boys who were very near to death in football are now strong men; one, I believe, is a missionary, the other in the army." A head-master says: "We have had several cases of fractured clavicle, and many sprains. They have always been the effect of football or gymnastics, chiefly the former. Regular games are not more liable to accident than casual practice." Again: "The worst mischief is done when no organised game is being played." Another says: "Accidents have generally occurred when by reason of the weather the boys were unable to play in the field." Another from a well-known school says: "Accidents seem to me more to be apprehended from confused hustling than when any regular game is played uuder strict rules." From one of the large English public schools comes the opinion of the head-master: "I believe they (athletic exercises, &c.) cause fewer accidents than would

arise if boys were to invent their separate forms of scrambling exercise. I think it is an exaggeration to suppose many accidents from games, even football." The medical attendant of 260 boys writes: "As a rule football is accompanied by more accidents than other games. We have had more severe injuries during sky-larking, &c., than during games, but accidents are more numerous during games." Again: "Quite as many sprains, bruises, cuts, from this source (sky-larking), as from all the organised games put together—none, however, very serious" (school of 500). From one of the largest of the public schools: "Football is the game which produces most accidents, but we have had very few of these." From the head-master of another, very nearly as large school, comes the following, which I think it better to quote to you at length: "The football accidents, though apparently numerous, are really trifling. On an average 500 boys play two games a week for ten weeks, giving a total of 10,000 games of individuals; the number of broken collar bones and arms may amount to two or three per annum. A broken leg or a serious brain concussion may occur once in ten years, *i.e.*, once in 100,000 games. Accidents to knees are most troublesome. There have been no accidents except one which I could consider really serious. This was a blow on the head, which was neglected, and it brought on serious inflammation, and required more than a year's rest."

These represent the general opinion, and coming from such important sources they are very valuable. They confirm the general results indicated by the previous rough statistics.

Having now ascertained that a certain proportion of accidents do occur, and that they are chiefly at football, and having further seen that unless some regular forms of exercise were employed the number and severity of accidents from irregular pranks and skylarking would be as great, if not greater, than from football, we have next to consider whether or not the risks might be lessened, and if so, how?

There is a considerable difference of opinion expressed in answer to Questions III. and IV. Some think no change need be thought of; some hold that the Association game is the safer; some that the Rugby form is, while others, the Rugby with

alterations. It will be more satisfactory if I again quote to you the actual replies which I have received, so that you may hear what is said for yourselves.

That there should be no change, comes the following:—"Certainly not. I did think it necessary to stop 'hacking' (*i.e.*, voluntary kicking) at football seven or eight years ago; and did stop it. They [the games, &c.] are all right as carried on at (——" one of the largest Rugby playing schools in England). From another larger school, playing the Association type of football, the head-master writes: "No. The risk is hardly appreciable in most cases," and as to a possible change, he says, "It is unnecessary." The same head-master whose statistical remarks I quoted at length says, in reference to the Rugby game: "I do not think that any alteration in the rules of the game would diminish its roughness. The abolition of hacking was very desirable, but is now accomplished." Another says: "Certainly not; we exempt boys from football on a doctor's certificate," and he sarcastically suggests for lessening the risks, "to wrap boys in cotton wool, and let them play with umbrellas and goloshes." Five simply say "no," or "certainly not," while others, although not thinking it desirable to make any alterations in the rules, offer certain suggestions as to the manner of playing, which might tend to minimise the risks. Such are: "Our experience leads to urge strongly that boys should be arranged for games in clubs according to size and age." Also: "I suggest for football, that it should be held to be bad policy to come into collision with any one, excepting at the ball, and bad play to kick anything but the ball." Another says: "Football may become quite unnecessarily rough. Boys ought constantly to be reminded that perfect control of temper is necessary, and that they should play like Christian gentlemen." While another writes: "The only modification that occurs to me is to insist on training. Those who are regularly taught gymnastics, and who run their mile daily, suffer very little from the violence of football, for they are always in good condition, and fall like cats."

The opinions in favour of the Association game are as follows:— One head-master from a Rugby playing school says: "Personally,

I should like all football to be Association, but then I was at Harrow. For young boys Association is best." One who has adopted the Association game for two years says: "Perhaps the Association rules for football are safer than Rugby." Another who has done the same says: "Football, as played under 'Rugby Union' rules (is) dangerous from the system of 'collaring,' so called, which gives very heavy falls." In reference to "collaring," another writes: "Forbid 'collaring' below the waist, and so return to the original game;" while in regard to "Rugby Union" rules, a head-master writes: "I think that football would be much less dangerous if a ball might not be picked up off the ground, or otherwise, than on first bound: holding a runner is the great danger of football." From another school playing the "Rugby Union" rules, the master writes: "I should always recommend Association rules. I think that the class of accidents are here less grave, as not including injuries to the *head*, and possible injuries to the spine, simple fractures are probably the least serious injuries."

Among those in favour of the Rugby form of the game may be included several who thought the existing rules should remain as they are. One gentleman after stating that in his experience very few serious accidents had occurred, continues, "I believe the reason is that we play here the Rugby game without hacking, which is in my opinion the safest form."

Some general remarks may here be of service. One master says: "Any football which permits tripping up, or hacking, or off-side play, or charging at any player except the player who has the ball (and at him only directly in front), is in my opinion extremely dangerous." . . . . "In football, which is very severe exercise, the dangers to be guarded against seem to be these: Over-exertion (exhaustion), over-excitement, leading to rough or unfair play and consequent injuries." The other head-master of the same Rugby playing school at which the last writer is a master says: "Even football, if the main object of the game is the ball, and no play is allowed excepting *at* the ball, has never been dangerous" (he is speaking of thirty years' experience). "It is easy to make it a brutal game, by allowing charging and kicking *not at the ball*, but it is perfectly unnecessary to do so," adding,

"I may observe that I have been a great player of games myself, and practiser of all manly sports, and understand what I talk about." Such remarks would of course be equally applicable to either form of game, and would imply that if these dangers were avoided the risks of injury would be diminished.

Sufficient has been said as to the risks from football. Before taking up the question of colds, we may briefly refer to some dangers in other forms of exercise. A head-master already quoted says: "The runs require most care, but we very rarely have any serious results from them." Paper chases are here referred to. As to running races, several think that the strain of a long race is likely to prove injurious, but only one gives any instance of this, and we may therefore suppose that, as Mr Morgan shewed by his researches into the after-health of the Inter-University boat crews, the real danger is often not so serious as it might appear. The opinion of one of large experience may, however, be quoted: ". . . . I should have more fear if rowing or gymnastics were to be largely introduced here, especially the former. I judge from my experience at Cambridge on this point. Rowing gives no pause to an exhausted boy, he must row on till the boat stops. At cricket and football pauses are frequent and are taken unconsciously; cases of exhaustion are almost unknown, though of great fatigue, common. In this respect also the racing of athletic sports, as mile races, &c., compare unfavourably with cricket and football." These are all that I have received, so we may now pass on to consider the risks from colds.

As might have been expected these risks are not inconsiderable. Most of the answers to the question allude to the dangers of sudden chill after exertion and over-heating, but a large proportion point to the greater risk run by those who are hanging about the ground as spectators of the matches and games. Many of these answers are important and suggestive, so I trust that you will allow me to quote again verbatim. "More colds caught from being mere spectators than from actually joining." "In my experience spectators suffer more from chills and colds than those taking part in the games." "Yes, from being spectators, either standing in damp grass for football, or lying down on grass to see cricket." Several more express precisely the same opinion. Another replies:

"Undoubtedly chills have been taken after football, both by players and spectators." Two have not only observed these results, but offer sugestions for avoiding them. One replies: "Of course, and therefore great care is taken to prevent boys as far as possible from lying down on grass, standing in rain without coats or umbrellas." The other says: "After games certainly, unless the rule of changing directly on getting home is enforced, but spectators at football are in greater danger than players. All our boy spectators at football have always either to play for twenty minutes after a match is over, or to run about a mile and a-half. Spectators at cricket should not be allowed to lie on the grass except on a rug." A similar reply runs: "Chills occasionally occur to players from standing about after being heated by games. Not if flannels are worn, and changed directly after the games. Even in rainy weather I do not often trace illness to the game itself [cricket is worse than football here, owing to the standing about]. But to the *spectators,* the risk of cold is very great indeed. I consider that the looking on at football and athletic sports is our most fertile source of coughs and colds, and the illnesses following upon them." Those schools who have not observed ill effects from chills among the players or spectators are in the minority among the replies, and I have thought it better to draw attention to this subject, so that precautions may be taken to avoid the risks from cold.

By the next question, *i.e.*, as to whether there was any additional bad result from athletics and not included in the previous queries, I wished to see if heart or lung injuries were ever found, as theoretically they have been supposed to be caused by these games and athletic exercises. It is somewhat striking, however, that in no case is there any allusion made to the heart or lungs as affected in the way indicated. Most have simply negatived the question, while the few who have entered into it have mentioned other points. Only one of these I shall now bring before your notice, as the rest belong to a later part of our lecture. This one is: "I think that constant scrimmages fostered by picking up at Rugby football strains a good many backs. The picking up was introduced by a number of thoughtless young men who cared only for their own game. The ball should only be picked up on first bound."

The two next questions, vii. and viii., may be taken together, as they both refer to the health of delicate boys, and were framed with the object of finding out what compensating advantages there might be in athletic exercises for the possible ill effects which it had been the main purpose of the previous questions to elicit. The first of them asked if *any* change had been observed in the health of boys previously supposed to be delicate; the second asked if there were any class of delicate boys whose health was improved and any whose health was injured by the sports and games. Very few have attempted to deal systematically with this last one, but a large majority have testified as to the improved strength and vigour under systematic exercise of boys who had come to school as indefinitely "delicate." Some of these are more guarded than others as to the chief cause of the improvement.

The medical attendant of a school of 600 boys says: "Delicate boys without positive disease almost invariably improve in health under the judicious use of gymnastics and games and athletics. A head-master who has studied the matter most carefully writes: "Often a great improvement, both in physical and moral health, never the opposite." Another with 250 boys under his care says: "I have had many delicate (not diseased) boys: invariably improve with the exercise of regular athletic games." The experience of one who has spent his life as boy and master at public schools is, that "speaking roughly from impressions, not statistics," 90 per cent. are benefited, 3 per cent. injured, and 7 per cent. are unchanged. Several replies similar to one another may be given consecutively. "Yes, great development of bone, change of weaklings into strong young men." "Yes, weakly boys become stronger, flabby boys more healthy." Again, "Very great benefit from both gymnastics and football. The change in delicate boys is often most marked, of course from their blood being better oxygenated, and their chest girth increased some inches." Also, "There are few boys so delicate that games do not do them good." And, "We have had many delicate boys whose improved health I attribute to the games."

Of the replies less distinct as to the cause of the improvement, I may quote the following: "It is difficult to say that one has

distinctly done so. I have known numbers of delicate boys who have greatly improved in health at school, but there are other causes which assist in this, so that one is careful in stating the matter too positively. My general *impression* is very decided that much good results to delicate boys from school games. I can state the converse proposition more decidedly. Many boys suffer in general health and elasticity who hang about or only indulge in desultory unorganised exercises." And another writes: "I have observed delicate boys who played games get strong and healthy, but I could not say it was directly attributable to the games." And others answer to the same effect.

The most frequent reply to Question VIII., the second of the two at present under discussion, is that no injury is known to have resulted to the health of a delicate boy, while many state at the same time that in cases of doubt boys are medically examined before being allowed to take part in the games and sports of the rest. Such a reply, which may be taken as a representative one, is the following from a school of 160 boys:—

"(1) I have never known a case during the time included in this statement (five years), where exercises and games did not act beneficially.

"(2) Boys are all examined by the medical officer and are not allowed to play when he forbids it. All play at some games, but about one per cent. are forbidden cricket and football."

The following are the answers where a classification has been attempted. From a medical attendant of a school of 260 boys: "Boys with sluggish circulation do well with sharp exercise. Boys with high spirits but rather weak bodies are liable to injure themselves." From a head-master who has paid much attention to the subject:—

"I. Boys beneficially affected are—1st, the large number not naturally delicate, but made so by coddling, and by a town life with too little exercise, and close hot rooms. 2d. Boys with consumptive or scrofulous tendencies.

"II. Those injuriously affected, if great care is not taken—

"1st. Boys with tendency to heart complaint.

"2d. ,, ,, ,, ,, rheumatism (from sudden chills)."

Another head-master gives as beneficially affected :—

"(*a*) Over-nervous boys—strengthened in mental fibre, cured of nervous habits, twitchings, &c.

"(*b*) Asthmatic subjects—relieved whenever they can play.

"(*c*) Weak circulations strengthened."

And as injuriously affected, "Boys above sixteen, with a tendency to weakness of heart."

These answers are, to say the least, suggestive, and they may serve as the basis for future observations for others who have not previously directed their attention to the subject.

The ninth question as to immunity from epidemics was asked, to see if the vigour of the athletic boys had been sufficient to enable them to throw off any tendency to disease which was affecting others around them. I have, however, only received one or two distinct replies to this question; in the other schedules, either there have been no epidemics at the school, or all the boys have been players, or where there have been epidemics no distinction between players and non-players has been observed. Several express opinions as to what would seem likely, but these being only theoretical I shall not quote them. One who has made observations on the matter says: "Boys who are in football training can hardly take scarlet fever. If they do take it (and I have only known one or two cases), it is so mild as only to be recognised by the rash. For this reason, if scarlet fever is about, football players need to be warned to look out for the rash. We had one dangerous case, evidently from the effects of unrecognised scarlet fever. There has not been the same immunity from measles." Against this another writes: "On the contrary, though I have often tried to do so, I have seen no connection between the two." Evidently it will be extremely difficult to collect evidence bearing strongly on the question; and so contenting ourselves with having had the question raised, we must now leave it in its present condition of uncertainty. This, however, we do with the less reluctance, since epidemics in schools are fortunately rare.

The discussion of this ninth question brings us to the end of those ones whose purpose was to deal with what may be called the physical effects of physical exercise, and its advantages and

disadvantages in this respect. The tenth and last question was framed to draw out opinions on any other bearings that the exercise might have on those who took part in them, whether from an intellectual or moral point of view. Several included their answers to this side of the question under Query No. VI., but as I meant this to refer to physical conditions, I did not discuss these replies along with the others, thinking it better to leave them till the present time. For the sake of convenience we may group the replies as they bear—1st, on the intellectual, 2d, on the moral aspect of the effects of physical exercise, and in each case we may again subdivide into advantages and disadvantages.

The possible intellectual disadvantages are such as the following :—"The temptation to spend too much time on them (games), and to think too much of athletic success;" this comes from one of the largest public schools in England. Another head-master says: "Boys are so excitable that very little work is done just before an interesting match." From one of the larger public schools comes: "The worst result of athletic sports is the tendency in young minds to worship mere skill in games without reference to moral or mental qualities. The balance, however, is less in danger than it used to be." A medical attendant of 260 boys writes: "After hard games (matches) the boys are not in a good condition for their school work for that day." A head-master of 140 boys has observed that "a certain number of boys show a diminution of intellectual power in the cricket season." Not many speak of direct intellectual gain, because this is much concerned with the *general* vigour and moral force gained by athletic exercises to be noticed immediately, but such remarks as the following may serve to indicate the feeling on the question, "The worst boys intellectually, physically, and morally, are the loafers." Or again, from one of very extensive experience: "The boys who work hard and play hard do not ape the vices of men, and are free from the insidious evils that often fasten on unoccupied boyhood."

If now we turn to the moral and educational aspect of athletic exercises the opinions are, I may say, altogether favourable and very strongly so. A good deal that is discussed need not be

entered into at the present time, but much of what remains you will be interested to hear; and as before, I think it better to give you the exact words of the writers:—"Nothing has a more healthy influence in promoting manly straightforward conduct amongst boys, than well-arranged athletic exercises, especially such a game as cricket." Again, from one who has been quoted before as of very large experience: "Athletics even in excess are better than the alternative, lounging for the idle, overwork for the studious. Athletics have most valuable results on character (*e.g.*, good temper, self-control, endurance, self-reliance) as well as on health." Another writes: "Positive advantages of such games," their influence "for pluck, for organization, for rapid judgment and action, for judgment of character, and a thousand more which are familiar to any schoolmaster who knows that his business is to make men." Again: "School games do great good in securing regular exercise for boys, and promoting habits of temperance and self-control: without them there would be a great deal of lounging, frequenting of pastry-cook shops and the like." Another says: "I have no doubt from the observation of games generally on boys at school, that they brighten the intellect, give a manly tone to the character, and are a useful safeguard against vice." While another writes: "It is plain that accidents, serious ones at times, result from football, but the beneficial results in strengthening the bodily powers, training the temper, cultivating courage and endurance, and presence of mind in face of danger, and generally producing a fine fearless disposition, make it the finest school game. Again: "In my opinion morality is greatly promoted by games, as well as health. They tend to straightforward conduct, also temperance of all kinds. They encourage self-sacrifice for the general good." These, I am sure, are sufficiently clear, and I need not therefore trouble you now with any further quotations. They may have seemed tedious to some of you, but they have enabled me to lay before you the opinions of those whose position and experience best enables them to judge, in regard to many very important questions in the "use and abuse of physical exercise."

Let us now sum up briefly what the evidence comes to in so far at least as our present enquiry has carried us. First, then,

we may learn that the masters and medical attendants of our large schools have for years been very carefully considering the question of physical exercise, and its bearing on the health of the pupils. This is very important, for in discussing this subject many do not sufficiently realise, and some neglect altogether, the weight that should be given to the opinion of Head-masters. Second, that although they have not thought it necessary to keep an exact record of every injury or accident that occurred, still their distinct opinion is that even in what are allowed to be the most dangerous forms of physical exercise, the risks to life or limb are comparatively trifling. Third, that while the majority do not think that any change in the method of carrying out our present games is to be desired, still a certain number see room for improvement in various directions, and we may take it for granted that all believe that they should be watched with care to prevent any dangerous innovations. Fourth, it seems undoubted that if regular and systematic games were not played at school, the accidents from pranks would probably outnumber those that occur under the present system of organised games. Fifth, that much care is required to guard against risk of cold for those who have been taking part in the games, and still more in the case of those who are merely spectators. Sixth, that a large proportion of the so-called "delicate" boys improve in health and vigour under the combined effects of simple food and regular exercise, and the other conditions of a healthy school life. Seventh and lastly, that the evils from idleness and want of occupation in school hours without games, and with them the gain in fostering manly virtues, in developing the character, and in strengthening the tone and fibre of the individuals, is so manifest as to be worth possible risk to a few, and fully to justify the rule in many schools that games are compulsory for all except those who can shew a medical certificate of incapacity.

So much, then, for the evidence of others, especially on the subject of exercise in schools. I will now, with your permission, add a few remarks of my own.

In the matter of accidents at football and other forms of

athletics, I may state that my personal experience fully bears out the general conclusions to which the opinions already quoted have led us. I played Rugby football at school and college in all for about twelve years, and not only incurred no serious accident myself, but do not recollect any having happened in my presence, except perhaps some not very severe sprains and one or two broken collar bones. For some time I was obliged to desist from playing on account of a strain to the muscles of the back, brought on probably by continuous "scrimmaging" in a very heavy match, and on this subject I shall have a word or two to say further on. The effects of this sprain have long ago disappeared, and in every way I believe my health to have been much improved by the game.

As some may not be aware of the points of difference between the two kinds of game, Rugby and Association, a few words in explanation may not be out of place. In the Rugby form the player is allowed to hold the ball and run with it towards his opponents' goal, while the other side may do their best to hold him, and take the ball out of his hands. In the Association game no one except the goal-keeper is allowed to handle the ball under any pretence, all management of the ball being done by the feet alone. From these points of difference many rules are framed, so that the character of each game comes to be considerably different, and the aspect of each to a spectator is quite distinct. In the Rugby game the arms, shoulders, and chest are much exercised in the efforts to throw off opponents while a player is running with the ball, or, on the contrary, while endeavouring to "collar" one who has already got it. Many tumbles are the result of these manœuvres, but they are more of wrestling fall than a complete throw, and are not nearly so heavy as they may at first seem. Tight scrimmages, too, are a feature of the Rugby game, and are the means of bringing the ball into play again after a player has been running with it and has been held. They consist of the forward players of each side wedging themselves together into a compact mass, and trying to push back their opponents, who are similarly arranged, the ball having previously been placed between them. After a few minutes' violent effort, one or other

side usually gives way or the ball gets loose, in which case the scrimmage breaks up, and the game goes on as before.

Under the Association rules, on the contrary, since the players are not allowed to use their hands or arms, there is no wrestling, and tight scrimmages are never formed. The consequence of this is that the game is much more open and free, the ball being always on the move, as it is passed from one player to another. But while the wrestling falls do not occur, what we may call complete throws are more common, for now, when a player wishes to upset an opponent when both are making for the ball, he must do it by a direct charge, or by a combination of charge and shoulder throw, which often results in heavy falls at full length. Another point to be borne in mind is that since the ball may not be handled, efforts are often made to kick it while it is still in the air, and this brings the foot of the kicker frequently into dangerous proximity with an opponent's body, should he be in the way. Fortunately, however, accidents from this cause do not often occur, although there is a risk of them.

Of the two games, the Rugby requires more strength in shoulders and arms, as well as in legs and back, while the Association requires more speed and activity, and greater neatness by managing the ball with the feet. The latter game has become extremely popular among the working classes of Scotland and the North of England, and has spread to a surprising degree within the last ten or twelve years. It is, perhaps, better suited to these players, since they do not so much require exercise of their upper limbs as of their lower ones, and since the rules, being comparatively simple, are more quickly picked up by lads who generally only begin to play after they have grown up. If, as is said, the accidents are less among grown-up lads in the Association game, this is another reason for its being played by those to whom a short time of work is a serious inroad into their means of livelihood. It is certainly a matter for congratulation that any game should have been found which attracts working lads to healthy open-air exercise on Saturday afternoons, and which draws out their friends in such numbers to watch them, as the Association game has been found to do.

As an exercise, the Rugby seems the better, since it developes

the upper part of the body as well as the lower, and, as a moral training, it seems also preferable, as there seems more scope for manly forbearance and good temper in its hearty rough-and-tumble struggles. The game might be improved, however, in a way calculated to lessen the risks of strain and crush, without taking away the good features by lessening the tight scrimmages as much as possible, and by encouraging a greater amount of "dribbling." One way to do this would be, as was suggested already, to allow running with the ball only from a "free catch" (*i.e.*, direct from the opponent's foot, before the ball has touched the ground), or on the first or second bound. The "forwards" at least might be thus restricted, and they should be enjoined not to avail themselves of even these privileges on all occasions, but to aim rather at concerted rushes in loose-scrimmage order; a plan of attack which is more effective than individual runs, even with good "chucking," while it is much more interesting to spectators. The objections to the tight scrimmages are that a very great deal of exertion is required with very little result; that any player getting on the ground might be seriously twisted or bruised by the wedged mass of his opponents surging over him, and that it forms a meaningless and uninteresting spectacle to lookers on.

A mode of holding an opponent by the neck and twisting his body on to the ground, known familiarly as "scragging," is strongly to be deprecated. It is not, at present, considered good play, but as there is no rule against it, the sooner it comes to be classed with deliberate hacking and expunged altogether, the better for the game. This is the more necessary when we remember that the great beauty and attraction of football is that it is, to a certain extent, rough and, within limits, even violent: otherwise it would not be the grand winter game that it is, available in all weathers, except in frost and snow, giving exercise, short, sharp, and bracing, and offering an indescribable charm and fascination to youths and young men "whose glory is in their strength" and who "rejoice as a strong man to run a race."

Now as to the dangers of football. What we have been speaking of to-night up to the present is the dangers of football as carried on at schools, and I hope I have been able to show you that here

the risk of serious accidents is really small, and much less than is generally supposed. Whence, then, comes the idea that football is so dangerous? A certain number of serious accidents do occur at football, but these are chiefly among the clubs of young men playing the game, and not among boys. There are several reasons why this should be. The men are heavier and stronger, but at the same time are not generally in such good condition, consequently being less firmly braced together, they are apt to fall more awkwardly, and are more fatigued by the exertion that is necessary. I have not been able to make particular enquiries so as to get more exact information, but I have referred to the serious and fatal accidents that have been published for some years past, and have found them almost invariably among young men, and chiefly among delicate ones working very hard in offices, who would have been better not to have played at all.

But even if we take the accidents at their worst, we find that they compare favourably with those at any of our other active out-door sports. In the hunting-field deaths are almost proverbially common, but does any one think of stopping fox-hunting on that account? In proportion to the numbers who annually ride after the hounds the risk to each one is comparatively trifling, and if we turn in the same way to football, out of the larger number of those who pursue the inflated leather case (and on their own legs), a very small proportion indeed are ever seriously injured. For an idea of the numbers, look even at last Monday's *Scotsman;* there were no less than 63 football matches, including those of schools, reported as having taken place this day last week, with probably as many again not dignified enough to appear in print, and I have no doubt there were as many to-day. Most of these were in and around Edinburgh itself, and I am certain that they do not represent half the number that were played in Scotland alone, and what number of players do they point to? Allowing, say 30 of them to be Rugby matches, with 15 a-side, or 30 players, and 33 of them to be Association, with 11 a-side, or 22 in the match, we have thus altogether 900 Rugby players and 726 Association, in all about 1600 players; and doubling this as an estimate, certainly much within the mark, for those playing in Scotland, we have a small army of 3200 football

players, stripped and ready for action, on Saturday week alone. When we hear of an accident in the football field, let us not forget out of how many this comes, and really what a small risk there is to each. But what of the advantage to the rest? Are you not now able to judge for yourselves how essential it is that lads and growing boys should have fresh vigorous exercise in the open air? Do we forget that football is strengthening their bones, expanding their chests, developing their muscles, and sending them out more manly vigorous men into the world to fight their battle of life? And if a very small minority suffer in the process, is it more than this world, with its mixture of good and evil, has ever brought us? If you ask why not minimise the evil, I reply by all means, and I would gladly do all I can to help, but don't let us lose sight of the advantages which we gain from the game. One thing above all others I would ask you to keep clearly in view, and that is, that unless the game afforded scope for strong and hearty exercise of muscle, it would be no attraction for strong and hearty young Britons. Until, therefore, we find a game which will give this scope to as great a number, and at in every way as small a cost of money, time, and limb, I trust it will long maintain the place which it now holds as our leading winter game.

But there are other forms of physical exercise to which I must very briefly allude, and one of these is athletics, meaning by that the various competitions in running and jumping. There, as elsewhere, it is difficult to lay down precise rules, but in races I would say there was a certain risk of boys over-exerting themselves. Overgrown lads, for instance, should be carefully watched, and in certain cases should be prevented from *competing* in races, although in the quieter preparatory practice for them a systematic and regular exercise is often afforded which is calculated to be of as great a service. Training properly carried out should never be omitted for a month or six weeks before a race, but it should consist of regular systematic practice, with sound wholesome diet, not the rigid dietary chiefly consisting of animal flesh which is a descendant of the empirical methods of our old prize-fighters, and the exhaustive physical work which some of our professional athletes think it necessary to insist on. As to diet, I can speak

from experience, and have found that the abstinence from fats of all kinds, as well as from potatoes and other sorts of starchy foods, is not only scientifically incorrect, but often produces a disorder of the system which materially interferes in the very objects which the training has had in view. Of course plenty of exercise and practice at the required distance must be taken, but this is not more than should be enjoyed by a healthy young man or boy whose life is regulated by physiological principles, not by the artificial requirements of the unwholesome side of our modern life.

As to golf, I hope many of you know what it is—one of the very best games that can be played at from boyhood up to old age. Time was when Bruntsfield Links give scope for a refreshing round for many of our jaded citizens, but now the traffic on and round that piece of ground has grown so much that the game is a source of pleasure no longer, either to those who play or to those who are passers by. If, then, the proposal to open up a Links on the Blackford Hills could by any means be carried out, it would be a very great gain to the city. One might easily dwell on the delights of golf, but our time is limited, and I must pass on.

As to lawn tennis, I need not detain you. It is one of the few games that can be played at by both sexes together. Admirable in its way, it is sometimes only too attractive, and harm has been done by its over use. From an hour and a half to two hours daily is probably as much as is good for any one, a caution which is especially necessary for some of our lady players. Men play in loose flannel, girls often in tight garments which are in every way unsuited for active exercise.

I shall not dilate on walking, more than to say this, that it is really the ground-work of all exercises, and should form part of the daily work of all. If this be the only available form of exercise, about two hours daily of sharp walking has been estimated as sufficient to keep an average man in good health; and it is as well to remember that with accelerated speed the exertion is called out in a rapidly increasing proportion. A pleasant companion in the walk is a very important item, and is just what makes the difference between an agreeable occupation and an irksome duty.

Riding, I must pass by with the single remark of commendation for all who can afford it; but on the subject of fives or hand-ball, I feel bound to ask your attention for a very few minutes. This is a game which is, unfortunately, only too much neglected, which is the more to be regretted since it is peculiarly adapted to the wants of those who live in towns. It only requires three walls and a limited space, needs no grass, and affords most bracing and exhilarating exercise in a short space of time.

The full-sized court in which it is played consists of a cemented or paved floor about 30 ft. long by 16 ft. broad, a back wall 16 ft. square, and two side walls beginning at 16 ft. high at the one end and gradually sinking to about 5 ft. at the other. This is meant for four players, but a much smaller one would do for two. A small, hard ball is used to play with, and the object is to strike the ball with the palm of the hand against the wall so that it bounds back on to the floor of the court for the opponents to strike in a similar way. By using the side walls the ball is made to pass through many angles before it reaches the ground, and in consequence its course is the more difficult to follow. Either hand is used equally, and thus the exercise has the great advantage of being uniform, and bringing both sides of the trunk and chest into action.

With little expense fives-courts might be erected in this and other large towns, and their presence would be the greatest boon to lads in shops and offices, who are in close confinement the most of the day. Such courts are much wanted, and if any one could be found enterprising enough to erect them on some spare yard or little-used area, and make a small charge for each game, he would find it a good investment for his money, while he would at the same time be conferring a benefit on his town.

In schools, where any of the boys are prevented by ill-health from joining in the football and cricket of their companions, fives has been found very valuable as a safe and efficient substitute.

I might easily dilate on the place and value of gymnastics, but our time does not admit of it. However, I will say this, that, as a general rule, gymnastics in a regular gymnasium should be undertaken systematically under an instructor's eye. If boys are turned loose into a gymnasium, they will probably do themselves

more harm than good: the exercise should be designed for the requirements of each, and should be steadily increased. These objections do not hold good for the series of exercises without apparatus generally known as the "Ling system." I have no experience of this personally, but I believe that it produces excellent results in developing the frame, and has been found of special service in the case of girls, delicate lads, and children. For most children a little of the Ling system may be a good thing, but what I would recommend most of all would be hearty romping play, as much as possible in the fresh breezes of the open air.

From one of the headmasters comes a suggestion which is too valuable to be omitted. He says, "Another point might almost have a lecture to itself, viz., the place of hard *useful* labour in education. Boys should be taught at school the use of carpenters' tools. They should learn to use the spade and wield the pick-axe. There is much useful 'navvy' work they might do both for school and for public objects. Such work strengthens their limbs, forms a relief from the monotony of regular games, gives a sense of the true dignity of manual labour, and is a blessing to those who may be farmers, colonists, or employers of labour. No one can judge well about any work who has not done it himself;" and in support of this sort of work he adds, "Every stroke of the pick-axe is a blow against our enemies the snob and the 'culchawed' prig."

As regards physical exercise for girls, I can only now make a few remarks, and those chiefly of a general character. It is becoming more clearly recognised than ever, that although they are of the same stamp and mould there are essential differences between the two sexes in their physical, moral, and intellectual natures. The same elements are, so to speak, present in each case, but being differently combined, the result is two natures with capacities different in degree although not in kind. It is by no means necessary to argue from this any inferiority on either side, but that there should be recognised a difference in all points with a main element of similarity is necessary to the point of view from which I wish to discuss our present subject. So far, then, as there is the main element of similarity in physical con-

stitution, is it equally necessary for girls as well as boys to have abundance of physical exercise, especially when they are young and growing? but so far as there are points of difference, the *kinds* of exercise must not be the same. The more violent games, such as football and hockey, and probably, for most, cricket, are neither suited to the tastes nor to the physical constitutions of girls, since their more sensitive natures seem to shrink from the roughness of hand-to-hand struggles, just as their more delicate frames are unsuited for the violence of them. Therefore we may at once leave out of consideration for girls those forms of rough and violent exercise which have been so strongly recommended for boys. Any attempts which have hitherto been made to introduce them among girls seem all to have failed, and it is only natural that they should.

But it would be just as great a mistake on the other side to suppose, as many seem to do, that because girls do not care for violent exercise, they should have little or none at all. A great deal of harm is being done daily to the health of hundreds of girls from neglect of proper exercise, and it is high time that the attention of parents and teachers be seriously turned to this question. To indicate in a general way the forms of exercise that may be selected, we may take such (so called romping) games as hide and seek, "I spy," &c.; also skipping ropes, and dancing for younger girls, and for older ones besides dancing (under healthy conditions), all the above, as long as their dignity will permit, which is, or should be, much longer than most think. Lawn tennis and similar games should be encouraged, as well as skating and plenty of sharp walking and climbing, *with an object in view.* There should also be a certain amount of calisthenic exercise, gymnastics, fencing, and work with light Indian clubs and dumb bells. Scarcely anything more inadequate could be conceived than the montonous "two and two" promenade of the typical girls' school; the evils of this are so manifest that I need surely not enlarge upon them. Again, just as certain kinds of manual labour may be recommended with advantage for boys, so certain other kinds may be strongly urged for girls, *e.g.*, the milder forms of gardening, such as hoeing and raking, and a certain amount of domestic work, such as cooking, making beds, and dusting rooms,

if I may dare say so. The exercise of girls would require more care from those in charge than that of boys, to see in the first place that all do get a fair and regular amount of it, and in the second place to prevent some from taking too much. Often exercise for girls is brought into disrepute by the delicate and nervous ones over-straining their strength. It is just this keen nervous side of their nature, so sensitive and excitable, which exposes them to the risk of over-straining themselves mentally, and neglecting physical exercise altogether, that will lead them to take too much of it, if they are once strongly interested in it. A boy is not so easily moved, but with a comparatively small stimulus of competition or interest in mental or physical work a girl may be easily led to over-work, and do herself serious harm. Therefore, just in proportion as one would strongly urge physical exercise for girls to avoid the risks of over mental work in school, so one would caution against the risks of its over use as liable to bring into disfavour so excellent a cause.

Only one other point occurs to me as specially deserving our attention just now, and that is the *relation of brain work to exercise.* It must be in the experience of most men, that the fullest amount of brain work and of muscular exertion cannot be carried on simultaneously without injury to whoever is bold enough to try the experiment. Only a certain amount of nervous energy is available in the system. This may be expended either chiefly in muscle work or chiefly in brain work, or in a proportionate combination of both, but not in the fullest possible amount of each at the same time. Therefore when extra brain work is called for, we should not expect from our bodies the full amount of muscular exertion that they are capable of. Sufficient be it for the time if we get enough exercise to keep us in active health, and when we again have an opportunity, we can very soon bring our muscles up to their wonted standard. But since this preponderance of brain work in our modern life is so frequently unavoidable, it becomes all the more necessary that when the frame is still in its plastic condition, it should be stamped with the best possible physical impressions. The conditions necessary to attain this are not at all incompatible with sound mental training and earnest brain work, but it cannot go

along with that mental worry and labour which ought only to be found, if at all, among those who have reached maturity, and have passed into the active duties of life. A great deal of so-called "culture" and intellectual refinement may certainly be got out of some boys and growing lads, but don't let us be short-sighted as to what it may cost them. It may often be had, if you wish it, but consider first whether this or a vigorous active condition of mind and body are the most worth having, and we will then be able to regulate our means of training accordingly. To quote from Herbert Spencer, "the first requisite to success in life is 'to be a good animal,' and to be a nation of good animals is the first condition to national prosperity." If this be so, then it becomes us to see that whatever else we do we at least turn out our lads as strong and vigorous men when they start to their work among their fellows. I must, however, add a word of caution to those who in after life are unfortunately obliged to follow sedentary occupations. They should be careful how they return to their former activity. If caution be not used at first, the exercise will do more harm than good, so that it behoves us to be as careful as we can, always to begin gently and increase by degrees.

Had time permitted there are other branches of our subject which might have been considered, but we have already taken up enough, and of the possible ones, I think, the most important have been selected. You have heard the favourable opinion of physical exercise expressed by school-masters for boys in the middle and upper classes of life, and what is good for lads of one class will surely be good for those of another too. If I have succeeded in showing you that Physical Exercise is a good thing, and that it can be carried on especially by school-boys not only with little risk but with great gain as well, then I may feel that while my task is now ended, yours is only just about to begin. To you as to the Health Society of Edinburgh it only remains for me to hand over this important and responsible charge; that you do earnestly see to it, that before the city extends much further or many more years pass over our heads, there shall be for the poorer lads of our city a full and systematic provision for this great educational power, "Physical Exercise."

THE CHEMISTRY OF HEALTHY HOMES.

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PART I.

In the rapid advance which Chemistry has made in recent years, there is no department which has progressed with greater strides than the application of the Science to the discovery and elucidation of these conditions and laws which subsist between man and other animals, and the outer world, comprehended under the general title of Sanitary Chemistry.

It is now an admitted fact that the air we breathe, the water we drink, and the solid food we partake of, considered along with other conditions surrounding us, such as drainage, sewerage, and scavenging, have an important bearing upon the health of communities and of individuals. That when air is contaminated in towns, houses, and rooms by overcrowding, or by gaseous exhalations rising from deposits of organic matters, and from common sewers; or water is polluted in wells, cisterns, or vessels, by sewage matters and other noxious substances; or food in the ordinary sense is tainted by putrefaction or disease, then surely the health of the neighbourhood suffers. Whilst, when reasonable care is taken to prevent the overcrowding of districts, houses, and rooms, and for the ventilation of such, and precautions are adopted for the supply of wholesome, uncontaminated water, as well as for the aeration of drains and sewers, then the health of the locality becomes improved.

In the elucidation of the causes or conditions of sanitation, Chemistry has taken the foremost part. No doubt other branches of Science have done their work in the isolation and identification

of the germs and organisms which are specially concerned therein, but Chemistry must explain those atmospheric and other conditions which are concerned with the growth and sustenance—the development and propagation—of those germs and organisms.

Statistics now plainly prove the value of sanitary measures. The death rate and sick rate of many towns have been lessened or reduced in proportion as sanitary works have been carried out. Such health measures have consisted in the avoidance of overcrowding, the opening up of air spaces in towns, which are the lungs of a populous place, the systematic removal of house garbage and fulzie, the improvement of the water supply, alike as to quantity as well as quality, and the introduction of modern drainage and sewerage properly ventilated. These measures have succeeded in many cases in warding off fevers and other ailments, and in reducing the mortality from 28 to 21 per 1000 annually, being in the proportion of four deaths being brought down to three deaths, or 25 per cent. less, and virtually declaring that where four people died previously, then only three shall die now.

The most reliable of all evidence has been obtained from soldiers, sailors, and the inmates of workhouses, who are all more or less under restraint and discipline. This is specially the case with soldiers, where the discipline is more strict and obedience to orders can be more rigidly carried out. Moreover, statistics derived from a body of soldiers are likely to be more accurate than from a body of civilians, for they are men at the most healthy period of life, and who are not influenced by diseases of the infantile period or by the ailments of advanced life, nor even by the uncertainties of trade. The mortality in our army at home was so large that a Royal Commission was appointed to enquire into the matter, and they found that the sleeping room accommodation was very unsatisfactory, there being only about 2 per cent. of our soldiers who had the proper quantity of air for a night's rest. The practical results of the enquiry by the Royal Commission led to larger air space or sleeping accommodation being provided, and associated therewith, better water and more of it, better drainage of barracks, and better food and clothing,

and very speedily the annual mortality in our Army at home came down from an average of $17\frac{1}{2}$ in the 1000 to $8\frac{1}{2}$ in the 1000, being about the half of the previous death rate when sanitary measures were not properly attended to. The various branches of the Service participated in this favourable result, as may be observed from the following table :—

DECREASE IN DEATH-RATE IN ARMY.

Infantry Regiments,	from	17·9 to 7·6	in 1000
Foot Guards,	,,	20·4 to 9·1	,,
Royal Artillery,	,,	13·9 to 8·0	,,
Dragoon Regiments,	,,	13·6 to 8·0	,,

The subject of sanitary reform commends itself not only collectively to professional and municipal authorities, but individually to all of us, from the direct bearing it has on the strength and vigour, the health and life of ourselves and those dependent upon us. No doubt the physician and surgeon is now called upon to avert disease and ailment, as well as to cure it. The establishment of medical officers of health in our larger towns, and the diplomas in health granted by our Universities and Royal Colleges, sufficiently prove the importance attached by authorities to preventive medicine. Likewise our Municipal authorities are now called upon, and in some instances readily and cheerfully respond, to be the regulators of the air of towns, by the removal of all filth which can generate noxious gases to pollute the air, by more efficient water supply, by more thorough drainage and sewerage, and the ventilation of such, and by the stoppage of noxious trades, and otherwise.

We must not forget, however, and when we remember, we must not neglect to act upon the knowledge that in other aspects, sanitary reform is of a private or at most of a semi-public character, and must begin at home, in the ventilation of our rooms and houses, and the efficient cleansing of such ; in cleanliness of person and clothing ; in proper food, both solid and liquid, and in thoughtful interest and supervision of all home sanitary affairs, and such not only for ourselves, but also for those who are dependent upon us and who are to follow us.

In Health Statistics, I should almost say in Death Statistics,

young children have a sad tale to tell even in this the latter part of the nineteenth century. They are the most delicate Health and Death meters. Taking the most recent available and trustworthy statistics of the mortality in the eight principal towns in Scotland, we find the following results :—

IN 1881, DEATH-RATE OF THE EIGHT TOWNS IN SCOTLAND.
AVERAGE, 22·6 PER 1000.

Towns.	Population.	Deaths at all Ages.	Deaths of Children under 5 Years of Age.	Proportion of Deaths among Children to all Ages.
Glasgow, .	512,034	25·2	76·7	41·6 per cent.
Edinburgh,	229,030	20·1	59·9	36·8 ,,
Dundee, .	143,045	20·7	57·5	37·7 ,,
Aberdeen, .	105,515	19·4	48·6	34·5 ,,
Greenock, .	69,141	22·1	61·6	41·5 ,,
Paisley, . .	55,841	22·8	59·3	34·5 ,,
Leith, . .	61,607	20·8	56·4	40·2 ,,
Perth, . .	29,844	21·5	51·4	28·7 ,,

Taking, therefore, the average death-rate in the eight towns to be 22·6 in the thousand, or less than 1 in 40, we find the deaths among children under five years of age were per 1000—Aberdeen, 48·6; Perth, 51·4; Leith, 56·4; Dundee, 57·5; Paisley, 59·3; Edinburgh, 59·9; Greenock, 61·6; and Glasgow, 76·7; being in the proportion of 1 in 20 to 1 in 13, or from two to three times the death-rate of all ages including the children; whilst the proportions of deaths in the eight towns of children under five years of age to deaths at all ages were—Perth, 28·7 per cent.; Aberdeen and Paisley, 34·5 per cent.; Edinburgh, 36·8 per cent.; Dundee, 37·7 per cent.; Leith, 40·2 per cent.; Greenock, 41·5 per cent.; and Glasgow, 41·6 per cent. So that in Edinburgh for every 1000 children under five years of age, no less than 60 die every year, and out of the whole deaths occurring annually at all ages, we have more than 36 in every 100, or fully one-third taking place in those under five years of age, or those just starting in the race of life.

The Chemistry of Sanitation demands specially a knowledge of

air, water, and drainage, and every householder ought to possess a sufficient acquaintance with these three health agents, and which may be conveniently referred to as the air factor, the water factor, and the drainage factor. To some extent these health factors may be considered as separate agents at work in influencing the health of every home; but yet in various ways they are connected and react upon each other, for the air of a house may affect the quality of the water supply contained in cisterns or vessels, and the drainage of a house may influence both the air and the water, and indeed often does. But each agent may have a separate consideration to begin with, and the connecting links may be observed afterwards. Besides these factors there are questions relating to food supply and clothing, painting and papering of rooms, use and abuse of disinfectants, and other topics which more or less concern health.

In the Chemistry of a Healthy Home the air factor ranks first. It is probably the most important, and all the more so that it is the most insidious and least capable of being observed. Besides it is the largest quantity. In any house, large or small, the water supply occupies little space, and the food supply still less; but our rooms must be capacious, so as to afford a full and proper supply of air. Were it otherwise, and if a home were a mere protection from weather, even a box, such as a sentry-box, for shelter and for sleep might suffice. Then a tenement of a few square feet of floor surface would be all that would be necessary, where during the day we might have standing or sitting room, and at night lying down room, with little more relative space than herrings in a barrel, or packages of merchandise on the shelves of a store. Now such will not do. Mere elbow room is not all, nor even the principal requisite in a home, for our houses and our rooms must not only shelter us and provide us with sleeping accommodation, but they must also be our storehouses of air food, from which we must by day and night derive our rations of air food.

To some extent we are careful that our liquid food is partaken of from clean vessels, and a similar remark applies to our care of the solid food, so as to be sure that we receive

it in a pure and wholesome condition. The stated supply of solid and liquid food on two or more occasions during each day is not more important than the constant supply of air food which in many occasions during each minute is partaken of by each of us, and is breathed into our animal system. It is true that we pay for the solid food, and we see it on our platter, and can touch, handle, and taste it, and it is equally true that we pay nothing directly for the air food, and that we cannot see, touch, handle, or taste it. But as certainly as the man has his ration of solid food placed on the platter before him, so he has his allowance of air food measured out to him in the home he may choose to inhabit. Hence the necessity for cleanly homes to yield cleanly air for our momentary wants by day and night.

The amount of air required by man depends not only on size or bulk of each individual, but also to a great extent on age and exercise or work. The number of respirations at various ages may be thus tabulated :—

Infants, - -	44	respirations in each minute.	
5 years of age, -	26	„	„
15 to 20 „ -	20	„	„
20 to 25 „ -	$18\frac{3}{4}$	„	„
25 to 30 „ -	16	„	„
30 to 50 „ -	18	„	„

The volume of the respirations is much influenced by exercise or work, as when the system is at rest the breathing is more quiet: when active walking or work is being gone through the breathing is not only more quick, but more earnest and deep. Thus the following results have been obtained for an adult :—

At rest, - - -	33·6	cub. inches in each respiration.	
Walking 1 mile an hour,	52	„	„
„ 2 „	60	„	„
„ 3 „	75	„	„
„ 4 „	91	„	„

And when these results are considered along with the frequency of the respirations under different circumstances, the following table may be constructed :—

Daily Respired Air.

Man at rest, - - - - -	686,000	cubic inches.
Slight exercise, - - - -	804,780	,,
Tradesman at work, - - - -	1,065,840	,,
Labourers at work, - - - -	1,568,390	,,
12 hours' hill climbing on the Alps, -	1,764,000	,,

It will, therefore, be found that an average sized man, engaged in very moderate work, breathes—that is, inspires and expires—about 1,000,000 cubic inches of air every 24 hours—every day. This amount is more than 500 cubic feet, and more than 3000 gallons of air. Were we required to purchase this quantity of air food, each of us would have to order a case or box full of air, 10 feet long, 10 feet broad, and 5 feet high, or if we choose to have it in quart bottles, we should have delivered to us more than 18,000 quart bottles per day. Indeed, for every hour we would require fully 20 cubic feet, being more than 120 gallons, and upwards of 700 quart bottles, and for every minute 2 gallons of air or 12 quart bottles. Just think of the alarm and dismay of every householder in the morning if the vendor of the day's air food was late in his call, and if the air boxes or bottles, like the rolls, were not delivered in lorries at the appointed time. Still more so if the manufacturer of the air, or his people, struck work for an advance of price; and worse still, if the air cleansing factory broke down or got burned up, and the material could not be supplied for love or money. We should then probably learn to hibernate for a time, like the Polar bear or the marmot, and go to sleep and hardly breathe at all.

We require not only quantity of air but quality of air to breathe. The atmosphere which surrounds us consists mainly of two gases, known to the chemists as oxygen and nitrogen. They are so largely present in the atmosphere that popularly we may say that the air is composed of one-fifth of the oxygen and four-fifths of the nitrogen.

Air Food.

Constituents of the Atmosphere.

Oxygen in 100 parts by volume,	- -	20·61
Nitrogen	,, - -	77·95
Carbonic Acid	,, - -	0·04
Water Vapour	,, - -	1·40
		100·00

Ozone - - - - -	traces
Ammonia - - - -	traces
Nitric Acid - - .	traces
Carburetted Hydrogen	traces
Hydrosulphuric Acid	traces in towns.
Sulphurous Acid	traces in towns.

The oxygen is a most important gas for the life of all animals. When mixed with the nitrogen, we cannot see its properties so well as when we collect it in bottles by itself, and experiment with it in a pure and unmixed state. When obtained pure, it is a clear, transparent, colourless, tasteless, and odourless gas, which does not burn itself, but which enables a splinter of wood, a candle, a piece of charcoal, a bit of phosphorus, and even a coil of iron wire to burn brilliantly in it. Indeed, it is a great supporter of combustion, and burns everything more readily than air itself. The energy of its action in causing substances to burn so quickly in it, is due to its intense power to combine with, or enter into union with, the materials which are being burned, and when taken in its pure state, the oxygen is enabled to exert its power quickly and vividly, because it is not diluted or mixed with nitrogen, as it is in ordinary air. When we burn a candle, gas get, or coal in ordinary air, however, the combustion proceeds because of the oxygen of the air meeting with the combustible substances, and the rapidity of the process is kept down by the large amount of nitrogen which is mingled with the oxygen in the atmosphere.

The nitrogen of the air when taken separately is also a clear and transparent gas, colourless, odourless, and tasteless, and neither

burns itself nor allows anything else to burn in it. The main function it fulfils in the atmosphere is to dilute the oxygen and give bulk and weight to the air.

The breathing of man and other animals, otherwise known as respiration, is practically a process of combustion. The air which is inhaled enters the lungs and then passes through into the blood. The lungs contain from 5 to 6 millions of air cells, which though minute in size, yet from their numbers have a large surface of from 10 to 20 square feet, and such air cells inpinging upon the blood vessels enable the air which is breathed in by the lungs to enter the blood. The aerated blood is constantly circulating through the animal system, and the oxygen of the air in the blood burns up animal matters, so that when the blood returns to the lungs it has lost much of its oxygen, and contains instead of it a decided proportion of another gas formed of carbon and oxygen, and known as carbonic acid. This gas can be produced out of the animal system by burning a piece of carbon in a vessel containing air or oxygen, and may be proved to be carbonic acid by adding some clear lime water to the vessel and agitating, when a milky liquid will be obtained owing to the formation of carbonate of lime or chalk. In a similar way, if a man breathes into clear lime water, the carbonic acid which has been produced by the combustion in the animal system at once renders the lime water of a milky nature. The same result will be obtained by breathing into an empty jar, and thereafter adding the lime water and agitating. We can thus prove the identity of the combustion of carbon out of the body, with the respiratory processes proceeding within the animal system, and demonstrate that carbonic acid is the product of both processes.

The change which takes place in the air during the act of respiration is very decided. When taken in a dry state, the atmosphere in country places or rural districts contains from 20·96 to 20·98 per cent. of oxygen, and only 0·04 per cent. of carbonic acid, and in town districts from 20·87 to 20·90 per cent of oxygen, and 0·04 per cent. of carbonic acid. The proportion of the latter is therefore very small, and indeed is only 4 parts in 10,000, or 1 part in 2500 parts. But when the

air is breathed out again it contains only about 18·50 per cent. of oxygen, and 4·00 per cent of carbonic acid, so that whilst the oxygen has diminished by about 3 per cent., the carbonic acid has increased to 100 times the original quantity. Such air must be very different in quality from the ordinary atmosphere, and indeed when collected in a jar, and a lighted candle is introduced, the candle is extinguished, and when an animal is placed in it, the animal quickly dies. The air, therefore, which we breathe in is flame- and life- inspiriting air, but the air we breathe out is flame- and life- deadly air.

Not only is the expired air loaded with the noxious carbonic acid, but it also contains much water vapour and organic matters. The water vapour is not only given off from the lungs, but also from the skin during ordinary times by insensible perspiration, and when we are doing active work, by sensible perspiration, when we are said to perspire. Taking the more quiet periods, every man evolves water vapour by the lungs and skin to the extent of at least one ounce per hour, which comes to at least 24 ounces, or a quart bottle full, in the twenty-four hours. We can all observe this by breathing against a cold surface, such as a looking-glass, when the lung water vapour gets condensed on the cold surface; and we can also observe the skin water vapour by the damp condition of clothing and of stockings, when waterproof or rubber coats and shoes are worn. In rooms we can notice the water vapour, especially in a cold night, as it condenses on window panes and oil-painted walls. In halls and churches you can still further observe it, and if you wish to make an experiment on the subject you can take a fish globe or water caraffe, put some ice-cold water in it, and place it in a crowded room or hall. The animal water vapour condenses on the outside of the cold globe, and ultimately drops from it. Taste that water, and it is mawkish from the presence of animal products which have been evolved with it; let this condensed water stand for a few days, and it will become somewhat fœtid, proving that it contains putrescent organic matters; and take a portion of it and examine it under the microscope, and you will find it the abode of myriads of minute living organisms, so numerous indeed that a single drop contains thousands, and so active that the busy life of a crowded

thoroughfare in our largest cities is not equal to the bustle of the denizens of our condensed animal vapour.

When the atmosphere is tainted by animal exhalations it is often an easy matter to recognise such when we enter from the open air into the crowded room or hall, and when, for a few minutes, the sense of stuffiness of the air, and even the odour of massed humanity is obvious. Of course, when in the crowd our sense of smell gets dulled, and requires a little sharpening by being again exposed to the outer air, before the nose recovers its proper functions. I know of no better place for demonstrating that human beings evolve by lungs and skin both water vapour and organic exhalations, than a well-filled railway carriage at a roadside station in a winter day, and where, when the train draws up, the window panes are found running with water, and as you enter you encounter a blast of fœtid vapour which almost overpowers you, and the stifling character of which is further evidenced by the sleepy, drowsy, and half-asphixiated state of the stupid occupants of the carriage.

Over and above the gases and vapours, the atmosphere of our rooms is liable to contain more or less dust diffused throughout the air. This dust may be partly visible at all times, and may be derived, to some extent, from the outside air during windy weather. The street dust of our large towns has been examined and analysed, and has been found to contain fragments of hay and straw, hairs and fibres, and pollen of plants, cotton and woollen filaments, wings and other fragments of insects, spores and germs of organisms, besides fine particles of lime, coal dust, sand, metal iron, &c. The dust taken from the roofs of houses, and even from the interior rafters, as well as that found on the tops of pillars, has been found to be similar in nature. The dust of our rooms, too, is of the same character, accompanied by minute fibres, hairs, and scales from skin. Even when the air of a room appears clear, as when daylight is streaming abundantly into it, the closing of the shutters, so as to leave only a slight chink for the sun to throw a beam of light across the room, reveals to the naked eye the numberless motes and particles which float about in the air.

The noxious effects of the gases and vapours we exhale have been at times mournfully illustrated. From our youngest days

we have all heard of the Black Hole of Calcutta, where 146 prisoners were confined with plenty of elbow room, but comparatively little air space, and practically no ventilation, and in a few hours 123 were dead, and only 23 survived, but with enfeebled frames which they never got the better of. Another catastrophe of the same kind occurred after the battle of Austerlitz, when 300 Austrian prisoners were confined in a small apartment with moving space, but not air space, and 260 died, leaving only 40 survivors with more or less wrecked constitutions. Again in a Londonderry and Clyde steamer some years ago, the steerage passengers were, during a storm, kept in the forecabin, and many died. But in most cases fatal results do not immediately follow, though the noxious effects are more or less apparent. The vitiated air in confined rooms, when breathed in part at least over and over again, soon throws the animal system out of tone, the general health becomes impaired, there is quickly a falling off in the muscular and nerve power, the man or woman becomes more or less unfit for work, the boy or girl more or less unprepared for school, and all become more predisposed to ailments, especially those of a pulmonary character.

The proportion of carbonic acid impurity in the atmosphere may be taken as the measure of the contamination, for though it does not include the water vapour and the organic exhalation, yet these have a certain relation in quantity to the amount of the carbonic acid. Every adult man evolves about 16 cubic feet of this noxious gas in the twenty-four hours, so that we may take half a cubic foot as a fair average amount yielded by every man, woman, and child during each hour. In our rooms, however, there are other sources of carbonic acid than the respiration of the occupants. Every gas jet yields it, and every candle and every oil lamp evolve it. Each small gas jet burning 1 cubic foot of gas per hour requires 10 cubic feet of air to burn it, and yields 2 cubic feet of carbonic acid, being as much as would be evolved by four of a family. An ordinary sized gas jet, say No. 2 burner, requires 25 cubic feet of air to burn it, and yields about 5 cubic feet of carbonic acid, being equal to ten of a family. A small paraffin lamp and an ordinary candle throw into the air as much carbonic acid as an adult. The combustion of these lights may not produce so much apparent

contamination as animal respiration, because the organic vapours are practically absent, but the quantity must be taken into consideration along with the respiratory products.

The necessity for the systematic removal of those aerial impurities from our rooms may be proved by their deadly character on flame and life. It is well known that where a candle or taper will not burn an animal will not live. It does not necessarily follow that where a candle will burn an animal will live, but where a candle is extinguished, you may depend upon it an animal will quickly die. Now take a jar of carbonic acid, and plunge a lighted candle into it, and the light instantly goes out. Indeed you can relight the candle, and place it in a second jar, and pour the carbonic acid from the first jar into the second, and again the candle goes out; and further, you can place the lighted candle in the open air, and pour the carbonic acid out of the jar and through the air over the candle, and though surrounded by the good air, yet our noxious gas extinguishes the flame or life of the candle. Even expired air blown from the lungs of man up into an inverted jar will extinguish a candle introduced therein, and demonstrates that the air we breathe out will not allow a candle to burn in it; and further, a candle or gas jet or paraffin lamp, when burning under a glass jar, pollute the air quickly, and speedily extinguish their own lights.

Now, how are we to guard our homes from the deadly influences we are daily engendering? First, we must have rooms airy, and not confined boxes; and second, we must see to the ventilation of our homes. The army regulations now demand that each man or soldier be provided with sleeping space in permanent barracks of 600 cubic feet, or in wooden huts of 400 cubic feet; when in hospitals at home, 1200 cubic feet, and at the tropics, 1500 cubic feet, or in wooden huts, 600 cubic feet. Take the soldier at home with the 600 cubic feet of air space. This requires a room 10 feet long, 6 feet broad, and 10 feet high. Of course an allowance must be made in a room for heavy articles of furniture, such as chests of drawers and our Scottish "kists," besides about 10 cubic feet for bed and bedding, and 3 cubic feet for an adult of 12 stone weight, as the rule is, that the space

occupied by a man may be reckoned by his weight divided by three. Even the 600 cubic feet for an adult is too small for sleeping accommodation, were it contained in a glass case, or the doors and walls hermetically closed to renewal of air, for a man will actually breathe nearly 200 cubic feet of air during an evening's rest of eight hours, and the mixture of this quantity of air which has actually passed through the animal system with the remaining 400 cubic feet would render the whole 600 cubic feet very noxious.

All modern sanitary experiments show that when the atmospheric amount of carbonic acid in any room rises from 0·04 in 100·00 of air to 0·06, being from 1 part in 2500 to 1 part in 1600, then the air of a room cannot be challenged as impure, but when the proportion reaches 0·07 and still more 0·10 in 100·00 of air, then the atmosphere of the room becomes stuffy, and organic odours can be observed. The permissible amount of carbonic acid which ought not to be exceeded in a room is 0·06 per cent., or an addition of 0·02 to the 0·04 of carbonic acid already existing in pure or normal air. Now an adult person breathes out $\frac{1}{2}$ or 0·5 cubit feet of carbonic acid every hour, and that will raise no less than 2500 cubic feet of air from 0·04 to 0·06 per cent. of carbonic acid. Such an amount of air for every hour of the evening it would be impossible to supply in any room of an ordinary house, provided the air did not become changed during the evening.

The renewal of the air in our homes must take place by ventilation, either insensibly and practically beyond our control, or sensibly and practically within our reach and guidance. The *insensible* ventilation occurs in every room, even when closed, by the wind causing the air to pass in and out through all crevices and spaces in doors, windows, and flooring, and even through the plaster walls, bricks, and stone, as well as by the vents or chimneys, when people are careful enough to leave them open. The *sensible* ventilation takes place by open doors and by open windows, either in the room or in passages or staircases. The principles of ventilation are very simple when you know what they are, and the practical application of those principles is very easy when you know how to carry them out.

The spent or noxious gases or vapours, including the carbonic

acid, become diffused throughout the room in course of time, though when evolved from the animal system, and from candles, lamps, or gas jets, they are heated and tend to rise in greater part to near the roof, and accumulate there. This is done in spite of the carbonic acid being a heavier gas than air when cold, being half again as heavy as air. The accumulation of the carbonic acid and other vapours in the upper part of the room may be demonstrated by placing two burning candles at different heights under a tall glass jar, when the products of combustion will extinguish the upper candle before affecting the lower candle. In many rooms the stifling effect of the air near the roof may be observed by mounting a table or a ladder; and further evidence of the deadly properties may be gained by the effect upon house caged birds, which are often found dead when the cages are hung near the roof.

In the ventilation of any room, means should be provided both for the ingress of pure air and the egress of the foul air. A single opening at the roof or the floor can at the least only provide very defective ventilation. A candle placed in a jar, open only at the bottom, will gradually poison the atmosphere sufficiently to extinguish itself, and a candle placed in a jar or bottle with the mouth upwards and open will also be extinguished; but place the same candle in even a smaller jar, with a comparatively small opening near the bottom for the admission of pure air, and a similar small opening near the top for the escape of the foul air, and the candle will continue to burn vigorously. In the proper ventilation of our rooms, we must provide equally for the entrance of the good air and the exit of the bad air. The vent or chimney must always be an important ventilator—very powerful when the fire is on and the long chimney heated, but also, though less powerful, when the fire is not used, provided the damper is kept open, and the vent is not choked with a bag of straw or other rubbish. Always keep the vent open. It is a good ventilator of any room. The amount of air drawn in by an ordinary room-fire during the hour, runs from 6000 to 20,000 cubic feet according to the heat of the fire. In any case, it must change several times an hour the whole air of an apartment.

The ventilation of a room may be assisted much during its occupancy by a reasonable amonnt of ventilation, which may be

carried out without draught. An ordinary wind blows at the rate of 6 to 12 miles an hour, and such would be unbearable in a room where people were sitting. A current of air going at the rate of a mile an hour is equal to $1\frac{1}{2}$ feet a second, and such a current is not perceptible to the senses. When the air is flowing at 2 miles an hour, or 3 feet per second, then the draught begins to be observed. Now take a room and place a ventilator on two sides of it. Let each ventilator be 12 inches by 12 inches, or a square foot in size, or what comes to the same thing let each be 24 inches by 6 inches, or 36 inches by 4 inches, or several smaller openings, making up, like these, 1 square foot of opening in all. Have the ventilators not exactly opposite to each other, so that the current may not pass straight across the room. It is wonderful what an amount of air can pass through such ventilators very hour. Take the current as 1 mile an hour, or $1\frac{1}{2}$ feet per-second, and these square foot ventilators will pass fresh air into the room, and remove the used or foulled air, to the extent of 90 cubic feet per minute, and 5400 cubic feet per hour. Reduce your ventilators by one half, and say that each is 12 inches by 6 inches, or 24 inches by 3 inches, or 36 inches by 2 inches, and let the current of air be 2 miles an hour or 3 feet in the second, and you have the same interchange of air, being 90 cubic feet per minute, and 5400 cubic feet per hour. Have your smaller ventilators, and the low rate of flow of air, viz., 1 mile an hour, or $1\frac{1}{2}$ feet per second, and you pass in and out 45 cubic feet per second, and 2700 cubic feet per hour.

Without any special ventilation at all, but leaving the room door ajar by a single inch, or at most by two inches, and having the chimney vent open, then the ventilation will proceed in a somewhat satisfactory manner, still more so if the window can be opened a little. If the lower sash be raised, and a slip of wood be inserted on which the window can be closed down, it will leave a ventilating space between the lower and upper sashes, which will be found most effective and beneficial as a ventilator without much down draught, as the entrance of the outside air will be directed upwards as it passes into the room. An ordinary window sash, 3 feet wide, if raised in this way by a single inch, will give 36 square inches of ventilating surface, and

if the air blowing at 2 miles an hour, it will pass 2700 cubic feet per hour. Now remember, I am not advocating the benefit of draughts of air, and am not recommending people to sit in draughty rooms, but I am indicating various modes in which the air of a room, when it is occupied, may be rendered less foul by animal gases and vapours, and may be kept more sweet and more healthy. The application of any one of those methods in each particular case must be left to the intelligent judgment of the occupants of the rooms ; and it is sufficient for my purpose that I impress upon all the necessity for the recognition of ventilating principles, and to the benefits to be derived from the practical application of such. Where a room can have ready access to the outer air, then the insertion of Tobin's tubes, which communicate with the outer air near the floor of the apartment, and pass up the side of the room for about 6 feet, so that the entrance air may be thrown into the upper part of the room, will be found very beneficial. In large halls, such tubes or shafts for the entrance of pure and fresh air work exceedingly well, and lessen much the stifling atmosphere, without giving rise to draughts of air. Any system of ventilating an apartment is most materially aided by a fire in the room, and the great safety in the occupancy of many of our small houses lies in the fact that the living and sleeping rooms are one and the same, and that the fire required for daily wants does triple service in the cooking of food, the warming of the apartment, and the ventilation of the home.

Whatever difficulties there may be in the ventilation of our rooms when they are occupied by sitters and sleepers, there can be none when morning time comes, and the husband goes to his work and the children to school. Then the intelligent housewife should see that the windows are thrown open, and if convenient the doors too, and let the fresh air flow in abundantly, not only to chase out the foul air, but to dry up the animal moisture, and burn up and oxidise the animal organic matters which have condensed on walls and furniture during the evening. Beds should be well aired, the blankets and sheets being turned over. Inattention to such aeration of rooms and to the proper daily cleaning of apartments and furniture leads to the encrusting of the walls, doors, and furniture, as well as bedding and carpets or rugs,

with animal organic debris, which in time begins to decompose, and communicates to the house a fusty and fœtid smell or odour, most difficult to eradicate by even half-yearly cleanings. These remarks should apply with greater force to bed closets than even to rooms themselves. All doors of bed closets should be kept wide open at night, if, indeed, they be not removed altogether. I believe it would be better to unscrew the whole of them, and let the day light and the day air as well as the night air have full access to the closets. The introduction of a ventilator in the back wall of the bed closet near the ceiling would be of service, if we only knew that the opening did not pass into some region worse ventilated than the bed closet itself.

The difficulties of efficient ventilation in rooms or halls where large numbers of people are congregated are admittedly great. A crowd of people in a field or even on a hillside, with nothing but the heavens above, often gives rise to headache and a feeling of faintness on the part of numbers of the crowd, especially if the wind is somewhat light. Still more so, we find the same sensations in the midst of a crowd on the street, and again increased if the crowd is in an enclosed space—say, between high walls or high houses. If there is difficulty in ventilating a crowd in such a confined place, there must be corresponding difficulty in ventilating the houses which may line the four sides of the square, and which may form one of the ordinary blocks of houses run up in this and other cities. Such confined blocks, with numerous room windows imprisoned within the four built-up sides, are common in our modern feuing plans, and the ventilation of the houses there are impeded much by such arrangements, especially when the houses are small in size, and do not run front to back, so that there can be no through draught, but the back houses must all depend on the comparatively stagnant and imprisoned air within the block for the ventilation they stand in need of. The opening up of pens, closes, or passages without doors would somewhat improve the condition of matters by causing more or less current in the aerial prison, but the proper remedy would be to ensure that one or two clear spaces from earth to heaven were left in each block.

Remember that the gases and vapours exhaled from our animal

systems by day and night form the atmospheric sewage of humanity, and the quantity of such is large. During each day every man, woman, and child consumes, on the average, 8 oz. or $\frac{1}{2}$ lb. of carbon within the animal frame, and such in the population of Edinburgh, viz., 250,000, gives 125,000 lbs. of carbon, or more than 55 tons, which calculated by the year yields 20,000 tons of carbon. As exhaled this carbon is evolved as carbonic acid to the amount of more than 60,000 tons annually from man alone. Other animals will yield as much, and coal-fires, gas-jets, candles, and lamps will bring the total carbonic acid up to at least 300,000 tons each year. When you add to that the water vapour from the lungs and skin, and which for each human being averages 24 oz. or $1\frac{1}{2}$ lb. per day, and for the population of Edinburgh 167 tons per day, or 60,000 tons per year, as well as that from other animals, and coal and gas, we get at least 200,000 tons of impure water vapour, making with the 300,000 tons of carbonic acid no less than 500,000 tons of aerial impurities from ourselves and our houses, which pollute the atmosphere and constitute the aerial sewage of the city of Edinburgh.

Granting that we who are the polluters do our duty to ourselves and our homes, and by efficient ventilation and cleanliness allow these impurities to escape from our houses into the open air, then we may rest satisfied that natural forces and natural agencies will not fail to assist us in getting rid of the pollution.

By the law of diffusion of gases, at work by day and night, in sunlight and in dark, in summer and in winter, all noxious gases and vapours which are allowed to pass into the open air are quickly diffused throughout the atmosphere. Winds waft the air to and fro on the surface of the earth. Rain showers tend to purify the atmosphere by washing down the impurities to fertilize the soil. Electric storms assist in clearing the air of noxious principles, and plants are ready to absorb the deadly carbonic acid, and give us back pure life-inspiriting oxygen in its stead.

Our part of the purifying work is very simple. All we need do is to cease imprisoning the polluted air within our homes, and put forth our hand to liberate the deadly and poisoned air, and the God-ordained natural forces and agencies then complete the mighty task.

The practical application of this lecture may be summed up in the following lessons :—

1. Pure air is food to us.

2. Polluted and stagnant air is poison, slow but not less sure.

3. Never let air stagnate in rooms or houses.

4. Have reasonable ventilation of our rooms, by open doors, or slightly open windows, or other ventilators.

5. Never shut dampers in grates, but remove them and keep the vent open.

6. Thoroughly air all sleeping apartments during the day, and lastly,

7. Assist and do not impede nature in the restoration of pure and wholesome air for the impure atmospheric sewage of humanity.

Remember, too, as household words for ourselves and our little ones—

That a healthy man in an unhealthy home is surrounded by circumstances which are opposed to the continuance of the robustness of his constitution.

That a healthy man in a healthy home has much in his favour in his sojurn through life on this earth, and

That even an unhealthy man in a healthy home has the advantage of much which will palliate his ailments and will tend to lengthen his days.

THE CHEMISTRY OF HEALTHY HOMES.

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PART II.

In my previous lecture I stated that in the Chemistry of Healthy Homes there were three important agents at work—the air, water, and drainage—and that these might be regarded as the principal factors in a home on which health and sickness much depended. These subjects were entitled to separate consideration, but thereafter they were interlaced or intermixed with each other, and became directly or indirectly connected in various ways. The air factor has now been discussed as far as time will admit for its separate consideration, though afterwards we will require to connect it with sewer gases and sewer air. So far as considered we have arrived at the conclusion that an abundant supply of pure air is required by all of us, and that such can be obtained, even in towns, by proper and reasonable attention to cleanliness and the ventilation of rooms. One other illustration of the benefits derived by animals from pure air and ventilation may, however, be cited. The mortality among the French cavalry horses was, some years before the Italian war, extremely heavy, being annually from 180 to 197 per 1000, and simply by providing better ventilation in the stables the mortality came down to 68 in 1000, or less than one half, whilst when in open barrack sheds it became much less, and during the Italian war the mortality was almost nothing from disease or ordinary ailments. A similar result has followed the better ventilation of the English cavalry barracks, and now the mortality among the horses is about 20 in

1000 annually, one half of which succumb from accidents and incurable diseases.

The water factor would fall now to be considered, but three years ago it formed the subject of my Health Lecture in this Hall, and the full particulars on this factor will be found in the lectures published in 1881. But a few important points must be alluded to to-night in order especially to connect water supply with air and drainage. Whilst the quantity of water we require daily is very limited as compared with air, yet the much less quantity does not necessitate nor even indicate that we should be less scrupulous as to quality, not only at the fountainhead, or well, or spring on the mountain side, but in the home cisterns we hold or store it in, and in the vessels we use it from. Remember we are all water animals more or less. Three-fourths of the weight of our bodily frame consists of water, which is coming and going, and the waste must be replenished by pure water.

In Edinburgh, however, the householder need not concern himself much with the source of the water. We know it is spring and mountain water, wholesome in quality, and enlivened and rendered palatable with pure country hill air. It is otherwise, however, with much of the water supplied to the smaller towns, villages, cottages, and even mansion-houses throughout Scotland, where the water from wells or so-called springs is more or less contaminated with noxious organic matters, including sewage products derived from drains and cesspools, and numerous instances occur every season where such polluted waters give rise to or aggravate many ailments leading to sickness and even death. Great care should therefore be exercised in using water for drinking and cooking purposes, the quality of which may not be known.

When we receive even pure water into our homes we often contaminate it, and render it more or less unwholesome. For instance in Edinburgh the water is liable to be influenced by storage in cisterns :—

1st. From deposits which form in the cisterns, and are not periodically cleaned out. Earth and clay brought in by the water, and separating as a deposit when the water comes to rest, and to which is added the dust of rooms where the cisterns are

in living rooms, or communicate with such, as well as the dust of streets where the cisterns are in garrets or above the garrets, and occasionally small animals which are drowned in the water.

2d. From gases and vapours evolved from the animal frame, including animal water vapour, with organic debris or perspiration, rising and condensing in the cold water of the cistern; also skin scales and fragments of hair detached from the surface of the body.

3d. From gases evolved from drains and sewers when the waste pipe, as it commonly is, has direct communication with the drains or sewers, or otherwise communicates with impure matters.

The deposits in the cisterns become specially noxious when putrefaction and decomposition set in, and the products derived therefrom contaminate the water. This is markedly the case when the house is shut up for some time, and particularly during the summer months, when the water remains stagnant in the cistern, and when drawn off at first is unwholesome and injurious, alike from containing lead and organic matters in solution and suspension. The remedy for such contamination is to clean out the cistern with a soft brush every month or so, and to exercise great care, when the house has been shut up, never to use water from the cistern either for drinking or cooking purposes until the cistern and pipes have been thoroughly flushed out.

The gases or vapours from the animal system also contaminate the water, especially in cisterns placed in living rooms. The complete remedy for such is to remove the cistern to some other place, but such is not always possible, and hence the partial remedy of the daily ventilation of our rooms, and the periodic cleansing of the cisterns must be depended upon.

The gases from drains or sewers contaminate the water in cisterns in very many cases. The position of the cisterns is often objectionable, being placed over the closets or sinks, and the exhalations rising and being absorbed by the water, which thus becomes tainted. But the great mischief arises from the carrying of the waste pipe directly or indirectly to the drains, and from the ventilation of the service box into the cistern. Thus the waste pipe is often led into the closet immediately beneath

the pan, though sometimes further down into the water. The result is that at all times, from the more or less foul water in the pan or bend of the closet, gases of a noxious character must ascend the waste pipe and hover over the water in the cistern. If there is a deficiency of water in the closet, and the end of the pipe be uncovered, the gases will more readily rise, and granting that the water luting of the closet bend be deficient, either by suction or otherwise, the drainage or sewage gases will rise from the main drain right up into the cistern. The same remark applies to the gases forced back from the main drains or sewers, and which will, in part at least, escape up the pipe to the cistern. Another source of the contamination of the water of cisterns is from the service box, with its connecting tube, passing up into the cistern. When the closet is not in use, the pipe is empty of water and so is the box. Whenever the wire is pulled, the water fills the box and drives the air contained therein—and generally a little of the water, by the tube—into the cistern. When not in use the tube or pipes and the box must be polluted with gases, and these necessarily contaminate the water of the cistern whenever the closet is put in use. Any cover put over the cistern will aggravate the evil, for the gases will then be confined and be more quickly absorbed. A remedy for the evils attendant on this form of closet, is to run the waste pipe right through the wall of the house, and to have the ventilating pipe for the service box taken to the roof of the house, or through the wall. The evils of the sewage contamination of the water in the cistern will thus be averted.

We must remember that water has an enormous power of absorbing gases and vapours and organic matters. Even pure natural water contains from 7 to 10 cubic inches of gases in the gallon, but these are pure and wholesome gases derived from wholesome air. When the water is exposed to noxious gases in cisterns, then the impure gases dissolve in the water and discharge the pure gases. When the water has become impregnated with organic debris, such impurity may at times be recognised by the addition of Condy's fluid, when the purple tint will be more or less quickly changed to a brown shade, but the water may be im-

pure though Condy's fluid does not act. Clearness and transparency of water are not absolute evidences of purity. The contaminating particles are extremely minute, and are invisible to the naked eye. The noxious germs and organisms are equally so. Sometimes they may be active and hurtful, at other times latent and comparatively innocuous. Such impure water employed in dairies even for washing the cans or vessels, and still more for diluting the milk, leads to the marvellously rapid development and propagation of the noxious organisms.

The drainage factor is now considered of the utmost importance by all sanitarians, and chemistry has much to say about it. Fresh sewage is comparatively sweet and harmless, and were it to have free passage onwards, it would keep fresh till it escaped from our towns, owing partly to putrefaction not having set in, and in other part to the aëration and oxidation due to the oxygen dissolved in the body of water accompanying the sewage, and which would at the moment of liberation tend to oxidise or consume the escaping gases, and thus render them innocuous.

Taking matters, therefore, as we find them in the water carriage system, we may consider the preventive measures which may be adopted to guard against the evils of this mode of the disposal of sewage. These evils are mainly due to the production of sewage gases in our drains and sewers, and to the passage or escape of these gases into our houses. The primary cause of all the mischief is the lodgment of sewage in the drains and sewers, especially at the bends and in the hollows and depressions formed by badly laid drains or badly founded drains and sewers, and where the levels are either originally not attended to, or the subjacent earth has sunk or yielded below. Another source of the mischief is where the drains are imperfectly jointed and luted, and sand and earth fall in, tending to choke up the drain more or less, and either forming an elongated cesspool, or even forcing the sewage out of the pipes altogether and saturating the neighbouring ground, which may be close to or underneath the dwelling-house.

The main preventive measure ought to be to look well to the levels and thorough and efficient jointing, which would ensure

the rapid and complete fall or run of the sewage from the house to the main drain, and thence to the point of disposal, either on land or in the sea. Part of this work would fall on the individual householders or house proprietors, so far as the private or service drains are concerned; and the other part on the municipal authorities, so far as the main sewers are concerned. There are many instances in which the private or service drain has been shown to be at fault, and there are no doubt many cases in which the evil may be traced to the putrefaction of foul deposits lying festering and decomposing in the main sewers.

The chemical nature of the sewage gases is generally misunderstood. It is commonly said that hydrosulphuric acid (sulphuretted hydrogen) and carbonic acid, which are readily recognisable in the emanations from decomposing organic matter, are the types of the noxious sewage gases. No doubt the gases named are destructive to life when in quantity, but I am inclined to the belief that the more noxious of the sewage gases are evolved at an earlier stage in the putrefaction of the organic matters, whilst the sulphuretted hydrogen and carbonic acid are produced at a later stage in the decomposition. In fact, I believe that the main danger lies in the earlier stages, when gases and vapours of a true organic and combustible nature are produced, accompanied by spores, germs, and organisms. In the investigations into the nature of the gases evolved from deposits in drains and sewers which I carried out at the time of the Water of Leith Drainage Scheme, and which were embodied in one of the Blue-books of the Sewage Commission, it was a rare thing to find sulphuretted hydrogen in the escaping gases; and the bulk of the sewage gases were found to burn readily, showing their carbo-hydrogen character. The latter are not so observable as the sulphur compounds, and therefore not so quickly guarded against. Moreover, any one who has inhaled sewage gas, either in our large sewers or when a drain is opened, knows that hydrosulphuric acid (sulphuretted hydrogen) is seldom present, but, nevertheless, the gases exert a most debilitating effect upon the general health and spirits, giving rise to prostration and heaviness, headache and nausea.

In the majority of cases, and in fact with few exceptions, it may be said that practically no precautions are taken in the construction of house drains and their attachment to the main drains to prevent sewage gas from passing back into our houses. The closets have generally a direct connection with the drains and sewers; and not only so, but the waste pipes from the cisterns have in most instances a passage to the sewers either indirectly through the pan or bend of the water-closet, or directly to the drains or sewers.

Take the case of ordinary house service and connection with drains, as commonly practised or carried out. The closet, sink, and washhand basin are directly connected with the service drain, and the latter with the main drain, and the only preventive as to the escape of sewage gas from the service or main drain into the house by either of the conveniences lies in the plumbers' bends, which ought to be kept full of water. The security in such an arrangement depends solely on the water luting in the bends remaining there in sufficient quantity, and not being forced by the pressure of the gases in the main drain. Now, many circumstances will tend to render this system of water luting defective. There is the difference in level of the water in the main drain from time to time during the day and night, and still more during much rain, when it may be running almost full. The large volume of air displaced by the water must find its way out of the drain by the weakest point, and if that be by the bends, then the sewage gases will be forced into the house. Again, without increasing the actual bulk of water in the main drain, a sudden passage down of hot water will raise the temperature, and expand the volume of air in the sewer, and thus force the bends. Moreover, the reversal of the temperature of the water in the sewer from hot to cold will cause a condensation of the volume of the gas or air, and the suction of air through the bends, with the consequent more or less emptying of the water out of the bends.

In the event of the sewer being directly connected with the sea, the rise and fall of the tide will bring about a difference of pressure in the sewers and drains, and also lead to the forcing

of the gases back into the houses. In short, the bend traps, taken by themselves, are not trustworthy. Two closets or sinks placed on different flats of a house will tend to react on each other, and empty the water out of the bends. Thus, a rush of water down one closet will cause a suction and empty the bend at the other closet, and similarly a rush of water at the second will empty the bend at the first. Indeed, a decided rush of water from either closet will tend to clear both bends of the water luting owing to the common pipe acting as a siphon.

To remedy this evil, it has been suggested, and is occasionally carried into practice, that a ventilating tube is inserted in the service drain between the main drain and the closet or sink drain. Thus the closet and the main drain or sewer are cut off from each other so far as pressure of air is concerned by the ventilating tube. Any extra pressure in the main drain or sewer escaping by the ventilating tube, and any pressure exerted by water flowing down the closet being also allowed to escape by the ventilating tube. Now, this simple ventilator is a decided improvement, but taken by itself is not sufficient. Safety still depends upon the bend trap in the closet remaining full of water, but a sudden rush of water down the closet will tend to empty the bend by the tube acting as a siphon, and still more readily will this happen if two or more closets or sinks are situated on different flats.

The remedy, so far as the service drains are concerned, must be rendered more complete. We must put a stop to the entrance of sewer air into the sanctity of our houses, where the noxious gases are not only driven in by pressure from the main sewer, but are sucked in by the draught of every fire in our rooms. And this stoppage of the entrance of the sewer air must be done by trapping, carried out in a thorough manner between the house connection and the main drain. And still further, we must ventilate the private or service drain by level ground ventilators where these can be put in, and by pipes where the situation will not admit of such. And, further, we must carry the separate closet pipes to the roof. The flooding of the service drains by the periodic, say weekly, discharge of a large body of water from

enter the sewer without heating the air above the water line in the sewer. In doing so it expands the air, which necessarily becomes more bulky. There is a definite law as to the expansion of gases by heat, which states that, taking the range from 0°C. to 100°C., being from the freezing to the boiling points of water, 273 volumes of air become 373, or more than a third of increase, so that under these extremes of temperature the 12,000 cubic feet of sewer air in every mile of main sewer would tend to become more than 16,000 cubic feet, or 4000 cubic feet would be dislodged from the sewer. But say that the hot water was sufficient to raise the sewer air only one-tenth of this, then 400 cubic feet of sewer air would be driven out of the sewer for every mile in length.

Now, towns have many miles of sewers, and the proportion of gas or sewer air displaced in each mile would be practically the same; and if we take 50 or 100 miles of main sewers, the quantity of sewer air evolved would be enormous. The upper ends of all sewers and drains and branches terminate more or less in or near our houses, and if there is no other escape for the sewer air, then into our houses the gas must go. Public authorities, as a rule, provide for the thorough trapping or sealing of all the street gullies, and there is no escape in that direction. Then, where the house trapping of the drain is weaker than the street gulley, and generally it is so, the house trap must yield, and the gas be forced into the houses. Moreover, as a rule, house fittings connected with baths, closets, sinks, &c., are notoriously bad, and are frequently fitted up with imperfect and leaky joints, and often the connection between the house lead pipe and the drain pipe is made within the house with bad cement, or no cement at all. Hence the saying, that our main sewers are retorts generating sewer air, which is led into our houses by our branch pipes or drains, in a manner similar to the retorts in our gas works, producing lighting gas which is laid on to our houses by branch pipes or gas fittings.

Now, what is to be done? First, we must stop the entrance of sewer air into our houses by trapping; second, we

must ventilate the private or service drain; and third, we must carry the drainage pipes to the roof. But having done all this, we leave the main drains still as retorts and as the principal sources of mischief, but with an increased difficulty of forcing a passage into houses so protected, and should the passage be forced, with a lessened evil by ventilation, which means dilution of the sewer air and a great deal more as we shall presently see.

The main drains or public sewers ought to have the pressure taken off, and the gases liberated without bringing such near our houses, and without fouling our service drains. Such can be done by (1) unsealing the street gullies; (2) erection of shafts, and (3) open street gratings.

The unsealing of the street gullies is not desirable, for this would lessen the power of retention of road scrapings and earthy matters which are swept along the gutters. And such would tend to block up or choke the main sewers, or at least hinder the ready flow of the sewage, and materially assist in forming deposits of organic debris in the main sewers.

The erection of shafts of large size, if numerous enough, would relieve the pressure, and admit of that part of the evil being removed. These shafts cannot be properly placed at the sides of houses, because they can only pretend to be escape valves or pipes, and no public authority should charge householders with the risk to health involved in having the open ends of our sewage gas retorts run up the sides of their houses. Of course the shafts might be erected in open spaces, and where such can be obtained, the pressure may be let off but with the minimum amount of ventilation. No one, however, would seriously think of ventilating a long corridor, or even a room, by high shafts run up at each end, but would desire to have more direct means for ventilating the corridor or room. The same principle ought to be applied to main sewers which cannot be properly ventilated by any number of high shafts.

When the true principles of ventilation are applied to the main sewers, the conditions are best fulfilled by open street ventilators or gratings on the level of the street. These gratings serve not only as escape valves when the outflow or inflow of the gases

a bath, or otherwise down the service drains, will also tend to keep them free and clean.

Where the closets ventilate into common stairs, as in many parts of Edinburgh, special measures should be taken to minimise the evil of this system by having ornamental gates at the street entrance wherever wooden doors are now placed, in order that abundance of air may enter, and the cupola, where there is one, should have a ventilating space underneath, or an upper stair window should be left open. In this way the foul gases tending to pass from the closets would be diluted with fresh air, and would escape readily, instead of being confined in the stair as at present, or only escaping into the houses on the various flats. The stairs which have no doors are preferable to those with doors, and the partially open stairs and landings, as practised in several new blocks of buildings in Edinburgh are an important step in the right direction.

Whilst the householder has been looking to the trapping, ventilation, and cleansing of his service drains, he should also call upon the municipal authorities to place the public sewers in a thoroughly efficient state, alike as to construction and as to ventilation. Sewage gases are formed more or less in all sewers, even when the fall or rise is good, from the greater or less amount of sewage glut which adheres to the sides and bottom of the sewers ; and, of course, still more are the gases evolved when the fall of the sewer is not good, and when deposits of foul matter take place, especially where junctions are made, or otherwise where obstructions take place.

The quantity of sewage gas passing or being driven from sewers fluctuates much. In the early morning, when little water is flowing in the sewers, there is necessarily a minimum amount of water, and the air space is large, but towards breakfast hours the flow of sewage is much increased—about one-half of the whole daily flow coming away during the six morning hours —and the increase in sewage must necessarily displace the air in the sewers. Moreover, during wet weather the surface water must raise the volume, and during a flood or storm of rain, the sewers become more or less filled up with water, and the whole

gas must be driven out. Of course even showers of rain will cause some displacement of air, more or less according to the rain-fall. The influx of hot water, as on washing days or from steam boilers, such as condensing water or the blow-off, will necessarily not only increase the volume of water in the sewer, but will also expand the sewage atmosphere by the heat alone, and cause much of the air to escape.

The proportion of sewer air thus displaced or driven out of sewers by the above means must be considerable. Take a medium sized ordinary street sewer of improved shape, say 2 feet 6 inches by 1 foot 6 inches, which would present fully 3 feet of superficial area. A mile in length of such a main sewer would have more than 15,000 cubic feet of capacity, and granting that the minimum flow of sewage in this sewer is one-fifth of the total capacity, or 3000 cubic feet, the sewer air capacity would be the remainder, or 12,000 cubic feet. I say *sewer air*, because the air or atmosphere contained in the sewer is more or less contaminated with sewage gas. Now this 12,000 cubic feet of sewer air is liable to fluctuation in quantity from hour to hour, from day to day, and during dry and wet weather. At breakfast hours there is one-fifth more sewage, which means one-fifth less air, or 3000 cubic feet of sewer air displaced by sewage water, and driven out of the sewer in every length of one mile. During washing days, probably another one-fifth of extra water, and necessarily one-fifth or 3000 cubic feet more sewer air is driven out. In rainy days still more sewer air will be displaced, and during floods of rain the whole sewer air, or 12,000 cubic feet in every mile, will be driven out of the sewer.

When the town is situated on the coast, and the sewage is carried below high-water-mark, the rise of the tide will displace all the air in the sewer, and drive it out of the sewer, as the tidal wave rises twice a day. In towns where flushing is resorted to, the rapid passage of a large body of water down the main sewers must also cause the displacement, by fits and starts, of large volumes of sewer air.

Another element in the escape of sewer air from sewers is the change of temperature of the air itself. Hot water cannot

require such, but they do a vast deal more, and they truly ventilate the sewers.

Sewer ventilation, properly so called, ought to serve three conditions,—

1st. Admit of the ready escape of sewer gas.

2d. Admit of abundance of air to dilute the gas before escaping; and,

3d. Admit of so thorough an äeration of the main sewer, that any foul matter present there will be oxidized or burned up rather than enter into putrefaction.

The chemical action involved in the latter condition has not received that attention which it undoubtedly merits. It is strictly a chemical question, whether it is spoken to by chemists, by medical men, or by engineers. If any nitrogenous organic matter be taken and confined without ready access of air, it will enter into true putrescence. Gases of a most noxious character are produced, and, doubtless, at the same time numerous noxious germs or organisms. If the same organic matter be freely exposed to air, the putrescence is not so well marked, and oxidation soon takes its place. The gases produced are not so foul, and the danger is not so great. The free admission of the oxygen of the air tends rather to burn up the organic matter into comparatively harmless, though to some extent odoriferous, gases.

The same principles must be applied to our sewers. If we confine the organic matters there, then putrefaction in its more virulent and noxious form must take place; but admit abundance of air, and the putrefaction decreases, and oxidation now comes into play—and the more air, the more of oxidation and the less of putrefaction—reducing in fact the volume of putrefying gases to a minimum, and even when such are still produced in small quantity, they tend, by dilution with the larger volume of purer air, to be oxidised or burned, and are thus rendered practically innocuous. All of these conditions are best brought about by open street gratings numerously inserted in our main sewers. Sewage-polluted streams have their characteristic flora and fauna —vegetable and animal growths; but when abundance of pure water is allowed to flow down the stream, the sewage growths

which thrive luxuriantly in polluted waters cannot survive in the pure water, and the sewage life disappears. Doubtless, also, sewage-polluted air in confined sewers has also its characteristic spores, germs, or organisms which propagate in such polluted air, but when plenty of pure air is passed through the sewer, the noxious spores, germs, or organisms must fail to be produced, and must cease to exist.

Any notion of partial failure of the open street grating ventilators to remove every particle of smell, should only lead to a thorough inspection of the sewer in the neighbourhood as to its condition, and as to any deposited matter lying therein, and probably another ventilator or two introduced into the immediate locality may remove the offensive smell altogether. At all times we must remember that it is infinitely better that sewage gas should escape openly into our streets than steal insidiously into our dwellings; and that at the worst, the open street ventilator can only evolve a very dilute and practically harmless air compared with the foul tainted gas, teeming with noxious spores, germs, or organisms, which the unventilated street sewers can discharge into our houses.

The practical application of the system to Edinburgh is obvious. At present there is really no ventilation of the main sewers, which are the principal sources of the noxious and dangerous sewage gases. Some private drains are ventilated, but as these should be trapped from the main drain or street sewer, they can be of no use in ventilating the main sewers. If not trapped, then the private drain ventilation is dangerous, for the element of true ventilation and äeration cannot go on, and the illustration of the main sewer being a retort, forcing sewage gases into our houses becomes a reality. The time is more than come when the thorough äeration of the Edinburgh sewers ought to be carried out, and it is improper to delay. Both theory and practice commend the system. It is possible that the condition of some of the Edinburgh sewers may necessitate rebuilding of such, but this is a lesser evil than to continue the use of an unventilated, bad sewer. The thorough ventilation of the main sewers of Edinburgh, combined with the periodic flushing out of such, to

remove sedimentary matter lodging there, would undoubtedly be a great boon to the city, and its execution should not be delayed.

The amount of air which can be passed through a main sewer is very large. Thus if there be a length of main sewer having two street ventilating gratings placed 100 yards apart, such gratings have each a square foot of open or ventilating surface, and if the wind be blowing at the rate of 6 miles an hour, which is equal to 9 feet in the second, the air will pass through the sewer at the rate of 540 feet in the minute, or 32,400 feet in the hour, and the whole bulk of air in the sewer will be renewed 100 times during the hour. This dilution and äeration renders it impossible that any injury can be sustained from the escaping gases. The air, however, often travels at a much higher speed than 6 miles an hour, but taking friction into consideration, and even reckoning that the renewals of air were only 50 times or even 25 times during the hour, we may regard the system as not only efficient but safe.

Moreover, the foremost sanitary engineers and health authorities are unanimous in sanctioning and recommending the system, and many towns in England and Scotland have demonstrated the benefits to be derived therefrom. To come near home, Glasgow has between 2000 and 3000 of these open street ventilating gratings connected with the main sewers at about 70 yards apart, and Leith and Portobello are provided with them. Why should Edinburgh stand still? These ventilators are all the more needed, now when our streets are being so thoroughly asphalted and cemented on the causeway that the carriage path is practically impervious to water and air, and any gases evolved from our sewer pipes and gas pipes cannot escape through the causeway, but must be driven out below the pavements and into our areas and sunk flats. The open street ventilating gratings would relieve the pressure of these gases, and allow them to escape in the centre of our streets.

Besides the ventilation proper, there should be periodic flushing of all our main drains and sewers, by the opening of sluices connected with large cisterns placed at proper distances

apart. A sudden escape of a large volume of water down a sewer at a given time would tend to float on all the solid debris lying in the bed of the sewer, and thus remove the cause of the production of the sewage gases.

The sewage gases, when taken at their smelling stage and when sulphuretted hydrogen is being evolved, are not necessarily at the most dangerous stage. The sulphuretted hydrogen is well known in rotten eggs, and no doubt when inhaled the gas by itself is more or less noxious and deadly, giving rise to drowsiness, heaviness, and headache; and when in quantity has proved poisonous to birds and other animals, including man. But the proportion evolved from sewers or other sanitary arrangements is comparatively small, and should rather be regarded as an index of other changes and conditions leading to the disengagement of more noxious and hurtful vapours, including germs and organisms which form the greatest danger. No doubt, all the stages may be regarded as going on at once in portions of the same organic matter, and sulphuretted hydrogen is the best telltale of the putrescence of the whole. Indeed the sulphur gas may be reckoned as the tail of a lion, of which none of us would be very much afraid if it were by itself; but where the tail is, depend upon it the mouth and claws are not far off. The two latter are the most deadly, and the former may be played with, but taken all together, they are to be avoided.

Chemical agents are useful in emergencies to aid us in combating with sewage gases and polluted air. There are different classes of such, such as deodorisers which remove odours; antiseptics, which stop or arrest putrefaction; and disinfectants, which stop putrefaction and destroy odours, even rising into the air to do so. The properties of the deodorisers, antiseptics, and disinfectants may all be found in one chemical compound, and the agent is the better and more powerful when such is the case.

For the development of putrefaction in organic matter three conditions are required: (1) dampness or water; (2) moderate heat; and (3) air for germs, spores, or organisms. When meat or organic matter otherwise liable to putrify is dried up, it retains its freshness. Egg powder, which is prepared

bolic soaps are now also used for the cleansing of clothes, the washing of hands of attendants on the sick, and for the treatment of certain skin diseases.

Condy's fluid requires a special place and special reference. It is an excellent oxidiser when placed on articles, or when such are put into it, but it does not rise as vapour into the air, and destroy gases or germs there. It is not a gaseous aid. It is, however, a very safe material to work with, and performs great service in the sick room, where it should be added to all utensils used by the sick.

The medical attendant on the sick will be the best judge of the special disinfectants which should be used in each case, and his advice should be rigidly and implicitly carried out in practice.

Remember, I am not recommending disinfectants as a general set off to uncleanliness in houses and their surroundings. I am merely speaking about exceptional remedies for exceptional cases. The proper remedy or cure is the natural one to remove filth or noxious material, and keep our homes and persons cleanly, and nature will do the rest. The daily removal of town garbage and fulzie by municipal authorities, as in Edinburgh, is the proper way. The accumulation of ashes and other house rubbish in middens and ash-bins, where putrefaction sets in, leads often during removal of the debris to sickness and worse, especially among children. Every householder should assist our municipal authorities in the rapid removal of the house debris, not only by himself, but by informing upon his neighbours who neglect to do so. It is often said that "one man's meat is another man's poison," and such is true, because one man will withstand influences which another man will succumb to. It is equally right to say that one man's neglect of sanitary measures or cleanliness may lead to disease and death in his neighbour's house. The natural outlet for putrescent solids—ordinary town or police manure—is the soil, which is nature's solid disinfectant, and the sooner the stuff is there the better, where it will fertilise the earth, and be not poison but food to plants, and through them in wheat, oats, or potatoes may become food even to man.

The natural outlet for the aerial sewage is the atmosphere,

where nature's air-disinfectant ozone is ever ready and able to help as the aerial scavenger to burn up our noxious gases. But do not throw too much on the air. There is a limit to its power of purification in towns and populous neighbourhoods. The soil is ever ready and is even greedy for manure food, and its capacity for absorption is practically unlimited, and all liquids and solids should be quickly incorporated therewith and be rendered harmless. Do not therefore hoard filthy matters in your homes, but send them at once to the fields to enrich the soil. Spare the atmosphere as much as you can. We require much of it, and should not needlessly pollute it by allowing putrescent matters to lie in our homes or around our homes which will evolve unnecessary noxious gases into the air. There is a limit to air purification, and even to the air itself. The height of the atmosphere is only forty-five to fifty miles—the distance from Edinburgh to Glasgow: an express train would run to the confines of our atmosphere in an hour—the time we have been in this hall. If the train halted a little less than $3\frac{1}{2}$ miles from the surface, the distance from Edinburgh to Portobello or Joppa, it would have left half of the air behind or below it, and would have only the other half in a more and more attenuated state to pass through in the remaining miles. The relative height of the atmosphere to the bulk of the earth is only 50 miles to 8000 miles, which is the diameter of our globe, or 1 to 160, being about the same as the thickness of a penny piece on a two foot globe.

A lecture on the Chemistry of Healthy Homes would hardly be complete without a reference to the cleaning of walls and ceilings, and painting and paper hanging. Before renewal of either paint or paper, the walls and ceilings should be thoroughly washed down, and the old paper hangings should be stripped off. It is absurd to think you get quit of a filthy ceiling by whitewashing over the dirt, and it is as fully absurd to suppose that the walls can be healthy if paper after paper is plastered over each other with flour paste. Such walls must always evolve gases owing to the more or less putrefaction of the coats of paste and paper. Never repaper over the old paper. Remove the old fusty papers and their coating of paste and dried up animal

by drying up eggs, is a good illustration, as the powder so obtained keeps all right. In various tropical districts, meat is cut into strips and dried in the sun, when it retains its good quality; and ordinary glue or gelatine being dry does not putrefy, though when made up with water and kept it rapidly gets mouldy. The absence of heat also preserves organic matter, as proved by cold or ice keeping meat fresh. The large importations of American beef into this country demonstrates this; and even from geologic times the mammoth elephant is found embedded in snow and ice in a preserved state. The absence of air with its spores, germs, and organisms, stops the putridity of meat and other organic matters, as observed in the large quantities of tinned meats, fish, &c.

As antiseptics proper, we can instance common salt, as in salted herrings and corned beef; chloralum; vinegar, as in pickles; and sulphites, such as bisulphite of lime employed for stopping the putrefaction of glue for paper size, and of meat by butchers, as well as hindering the turning of beer and lime juice. As useful oxidizers or aids in such, we have charcoal, which has been found of service in absorbing the noxious gases evolved from masses of putrescent matter when covering such, and in respirators to be worn by those who enter noxious localities, such as sewers; and caustic lime (lime shell in water), which is one of the best agents for sweetening the atmosphere of confined closes, areas, and stairs.

As powerful disinfectants we have chlorine in various forms, as well as burning sulphur or sulphurous acid, and carbolic acid. The chlorine by itself is a greenish yellow gas, possessing a suffocating odour, and rather strong for general use. In the form of bleaching powder it can, however, be obtained in a ready and available condition. A little powder placed on a plate and exposed to the air, evolves the chlorine slowly, and if desired that the evolution of the chlorine be greater, then some vinegar may be added to the powder. The chlorine has the power of causing the oxidation of the organic matter which it is brought in contact with, and can rise into the air and destroy gases and germs floating there.

The burning of sulphur or brimstone, which yields the gas

ordinarily known as sulphurous acid, affords also a powerful agent. 1 lb. of sulphur will yield 12 cubic feet of sulphurous acid, so that an ounce of sulphur will evolve three-quarters of a cubic foot of the gas. Before burning the sulphur in an apartment all metal articles should be removed, as corrosion of such will occur, and the windows and vent being tightly closed, the sulphur may be fired in a small iron pot, or on an iron shovel supported on a brick. The door being closed, the room is kept closed for at least two to three hours, after which the doors, vent, and windows may be opened for ventilation, and the room be thoroughly cleaned out. The fumes of the burning sulphur or sulphurous acid is a most powerful destroyer of living organisms. As little as one volume of the gas in 1000 of air will destroy ants and other animals, so that a couple of ounces of the sulphur burned in any ordinary apartment would be amply sufficient for its disinfection.

Carbolic acid is also an excellent disinfectant, and was known even in the days of Pliny, who states that it was prepared by the destructive distillation of wood, and that the liquor thus obtained was reboiled, and the heavy pitch oil collected on fleeces of wool. He talks of it as a "reddish pitch, very clammy, and much fatter than other pitch." We now obtain the carbolic acid from the coal tar of gasworks. It may be employed by itself as a useful disinfectant in many ways. Thus a little of the liquid when put in a plate, and some blotting-paper crumpled up and placed therein, readily communicates the vapour of carbolic acid to an apartment. The same thing will occur if a cloth be dipped in the liquid and suspended in the air. A wine-glassful added to a pail of water is useful for disinfecting clothes taken from a sick person, and which may be immersed therein; and a similar dose of carbolic acid in water may be successfully employed for washing the floors, walls, and furniture of rooms which have been occupied by infected persons. The liquid may also be beneficially employed in disinfecting closets, sinks, and drains, and in treating putrefying organic matters before removal. A handy form of the carbolic acid is given in the various powders sold in tins, and known as M'Dougall's and Calvert's disinfecting powders, and the daily use of such in closets and sinks will be found to sweeten the air. Car-

exhalations, and repaper on clean walls. A little oil paint on the woodwork, some whitewash on the ceiling, and either ochre or a neat paper on the bare clean walls, will sweeten any apartment, but beware of using arsenical papers, especially the greens.

The injurious effects of poisonous colours may be inferred from the fact that when such colours are used, either in distemper work or in paper hangings, the dust of the room taken from the floor or cornices, and from the ledges of doors and windows, the tops of wardrobes, &c., is impregnated therewith, and is always more or less poisonous, and the more the walls are dusted and the floors switched, the more fine and diffused will the poisonous dust become, till it settles down as an impalpable powder on the bed clothes and bed hangings, ready to be wafted again into the atmosphere by the motion of the bed clothes and hangings, and to be inhaled by the occupier of the room. And further, there is the probability of the volatilisation of some of the poisonous compounds as gas, either from the dry state, or still more so from the moistened surface, as where the walls are more or less wetted by respiration and perspiration during the occupancy of the room in the evenings.

The poisonous results have been markedly observed in the case of the arsenical colours where ailments have been directly traced to the poisonous colours; and, time after time, the story runs that whilst the room coloured with the arsenical material leads to sickness and all the symptoms of arsenical poisoning, yet all such symptoms have disappeared when the patient has either been removed to another room devoid of poisonous colour, or the room walls have been stripped and cleaned, and fresh paper or colour devoid of arsenic has been supplied; whilst a return to the room in the old state has led to a relapse and a reappearance of the poisonous symptoms. In my own professional experience I have never known of a fatal case of such poisoning, though I am conversant with many instances of illness, but deaths have been reported in various journals to be traceable to the use of such colours. Of course, some people are more predisposed to the influence of poisonous substances than others, and to one particular poison more than

to other poisons, and hence one may be affected whilst nine, or even ninety-nine, may escape without apparently being affected deleteriously. The same picking out of individual cases is observed with water containing lead impregnation, where one or two parties in a community may be influenced thereby, whilst the others are not sensibly injured.

The main evil is undoubtedly due to the use of arsenic in the colours, and the greens are more decidedly arsenical than the other colours, though colours and paper hangings of all shades and tints may be found containing more or less arsenic. The principal poisonous colour is the arsenical green, which is not arsenic alone, but a compound of arsenic and copper, known to the chemists as arsenite of copper, and which is often associated with acetate of copper. The various mixtures and shades go under the names of Scheeles green, Vienna green, Emerald green, and Sweinfürth green, and contain as much as 50 per cent. of arsenic, besides the copper and other substances. Arsenical yellow is a compound of arsenic and sulphur, or the sulphide of arsenic, and is known as Orpiment or King's yellow. Chrome yellow is a chromate of lead, and is not only used as a yellow, but is also employed largely in mixture with Prussian blue in the compounding of many shades of green. In oil painting, the various compounds of lead, such as white lead, which is a carbonate and hydrate of lead, red oxide of lead, &c., are largely employed.

Now there is no necessity for using these poisonous compounds either in distemper or oil painting, or in paper staining, and the best evidence of this is in the large assortment of colours which have been manufactured by Messrs Manders Brothers of Wolverhampton, specially for distemper work, and not one of which consists of or contains poisonous materials. The colours include lime yellow, Dutch pink, finest French ochre, golden ochre, terra cotta red, Turkey red, pale Indian red, Antwerp crimson, lime red, lime violet, lime purple, lime brown, Turkey umber, Bath stone colour, Pompeian green, sepiacine, pearl gray, blue black, deep Victoria green, pale Victoria green, pale lime green, willow green, pale sylvan green, middle sylvan green, pale sage green,

deep sage green, deep sylvan green, neutral green, torquoise blue (blue shade), torquoise blue (green shade), ultramarine blue F.A., ultramarine blue D, lime blue, indigocine, and permanent white.

I have tested every one of these colours, and find them to be entirely free from arsenic, lead, copper, or other poisonous compounds, and consequently they are entirely harmless, whilst the various tints and shades are everything which can be desired. Indeed, no better colours need be used on our walls, and I am confident that the employment of such non-poisonous colours, in distemper work especially, would materially add to the healthiness of the community.

The instructions for the use of these non-poisonous colours are very simple. All papers should be stripped off the walls, and any old colour carefully washed off. Where walls or ceilings are stained, they should have a coat of quick colour made of zinc white, good size, and turpentine. Good size for distempering is best made by dissolving in water over the fire 1 lb. of first class glue, and adding more water, so as to make a bucketful of size of about $2\frac{1}{4}$ gallons. The colour for the preparation coat should be made by slaking the whiting in cold water, and adding the proper proportion of the colour, then reduce four ounces of soft soap in warm water, and add it to each bucketful of stuff, and thin down the whole with jelly size until it is fit for use. Lay on easily with a flat brush, and allow to dry. The colour for the finishing coat should be made with more colour and less size than that for the preparation coat, and the soft soap should be left out.

When properly put on the walls, these distemper colours are quite firm, and do not rub off. The colours are not liable to fade and do not tarnish by gases. They are very cheap as compared with wall papers, are very suitable especially for bedrooms, and nothing can be more cleanly or pleasing to the eye.

In regard to paper hangings, I exhibit on the screens a large number of patterns, including all the principal colours, and ranging in price from a few pence per piece to the high class qualities. Some of the papers are arsenical and others are not. The arsenical papers include greens, reds, drabs, blues, &c. Looking

at the various tints and shades which are arsenical, and contrasting those with similar tints and shades which are non-arsenical, there is absolutely no reason why our paper stainers should continue to use arsenic in the colours they place on the wall papers. No doubt it may be urged that arsenical green especially is a cheap and pleasing colour, but the non-arsenical papers exhibited on the screens, and which have been manufactured and supplied by Messrs Wm. Woollams & Co., of London, prove that the best of colours and patterns and the most pleasing effects are obtained without arsenic, and can be guaranteed to be pure from that poison. I have tested all these paper hangings, and can certify that they are entirely devoid of arsenic or arsenical compounds, and yet the samples contain greens, blues, reds, drabs, &c., fully equal in all respects to those present in the poisonous papers.

The proportion of arsenic in arsenical paper hangings is often very large, and may range as high as 40 to 50 grains in the square foot of the paper. Taking 40 grains in every square foot, a large-sized room, which has about 1000 square feet of wall surface (making allowance for doors, windows, fireplace, &c.), will have 40,000 grains of arsenic on the wall paper, and a small-sized bedroom with about 500 square feet of wall surface, will have 20,000 grains of arsenic on the walls. The dusting of such a room must detach some of the arsenic and diffuse such into the atmosphere, supplying abundant means for doing harm. Taking the amount of arsenic as even 10 grains to the square foot, we have respectively 10,000 grains and 5000 grains surrounding the walls, a quantity still alarmingly large, and yet much below what many wall papers possess.

Many other articles than wall papers are highly arsenical. Thin gauze cloth may be purchased containing 10 to 30 grains o arsenic in the square foot. Green coloured paper, glazed and unglazed, used for covering pasteboard boxes and labels, &c., I have found to contain from 16 to 45 grains in every square foot. In fact, a bandbox having 3 feet of surface will have 100 grains of arsenic, a cracker box from 30 to 40 grains, the crackers themselves 2 to 3 grains, labels on tinned meat cans and bottles from 6 to 20 grains, envelope bands 2 grains, children's picture books

sometimes 50 grains; besides artificial flowers, children's toys, water-colour paints, and ball-room cards and tickets, &c.

I have made no reference to the ailments of the workmen employed in mixing and using such poisonous colours and in the cutting and hanging of arsenical papers, but I have evidence, and in the south very conclusive evidence has been obtained, as to the deleterious and poisonous influence of arsenic upon the work people engaged in the trade.

I would therefore urge strongly the discontinuance of all poisonous substances in the compounding of house paints and the staining of wall papers, and would recommend our colour makers and paper stainers generally to follow the example of those firms who have already led the way to this reform. Other countries, and especially France and Germany, have shown us a good way of getting rid of the mischief by passing very stringent laws regarding the use of poisonous substances in articles of common use, and recently the Prefect of Police in Paris has notified a most stringent prohibition regarding the use of poisonous substances in the colouring of even wrapping papers, and has intimated that manufacturers and dealers will be held responsible for accidents which may occur from the employment of such. We cannot do better than follow the lead taken by France and Germany in this matter, but until the legislature adopts the necessary stringent measures for the general safety of the public, the individuals of the community must protect themselves by insisting upon the manufacturers and purveyors of all colours and coloured papers guaranteeing that they are free from poisonous compounds.

A new and wholesome way of decorating rooms has lately been introduced into this country by the employment of very thin shavings of wood pasted on paper, and then employed as paper hangings or for covering woodwork. The Spurr's combined wood and paper veneers are cut from the natural wood by taking the logs, which are first halved or quartered, and bolting them in a revolving section of a ponderous machine, weighing about 30 tons. The cutting blade is 12 feet long, and the log is cut across the thickness, and not down the length. At every revolution of the machine a veneer 12 feet long, and from $\frac{1}{90}$th to

$\frac{1}{178}$th of an inch in thickness, is thrown off, but such must be done without vibration, as the machine must work true and almost noiseless, in order to yield uniform and proper veneers. These veneers are then backed with paper to prevent waste, and enable an ordinary tradesman to apply them.

The directions for laying the combined wood and paper veneers are that the plastered walls must be rendered quite smooth, and any defects be filled in with plaster. The walls are then sized with hot glue, using about a pound of glue to the pail of water. The walls are then lined with thin muslin, in applying which the walls are pasted, and the cloth is put on dry and well rubbed down. The combined wood and paper hangings are then damped on both sides freely, when the whole swells evenly, and any uneven edges may be cut away with a shoe knife. In fixing to the wall, the best flour paste must be used, and the wood and paper hanging be well rubbed down on the wall. After drying, the surface should be smoothed with sand paper, and if there be any stains on the veneer, these can be removed by a very dilute solution of oxalic acid. The veneer should then be finished or filled in with wax dissolved in spirits of turpentine, and using white shellac for light woods, and orange shellac for dark woods.

In the application of the various wood veneers to rooms and articles of furniture, &c., it is recommended that red cedar be used for closets; white wood, brown ash, or chestnut for pantries; mahogany and black walnut for libraries; black walnut for vestibules; silver birch, curly, bird's eye, and silver maple, and satin wood for reception rooms and parlours, with blue and gold decorations; and oak, ash or butternut for dining rooms. Ceilings may be made in every imaginable design, and wainscoting and wall dados in every device. Pianos, organs, tables, and other furniture may also be enriched in appearance in a similar way. The thinness of the veneers hinders contraction or shrinking by drying, or by alternate damp and dry weather. The lost sap is replaced by the wax, and all split panels or open joints are avoided by laying on the plastered walls at the extreme of the swell.

The advantages of the Spurr's combined wood and paper veneers may be summed up as follows:—

1st. The thorough natural character of the wood is obtained, and not mere imitation.

2nd. The beauty of the natural wood is brought out by the varnish.

3rd. The more perfect cleanliness, for the veneer hangings may undergo ready washing with soap and water.

4th. The non-liability to chip off, owing to the extreme thinness of the veneers.

5th. The improved appearance as age comes on, and which is well known in old wainscoting and panelling.

6th. The non-absorption of perspiration or animal exhalations, as in the case of ordinary wall papers.

The use of the combined paper and wood veneers has been going on now in the United States for fully twelve years, with increasing acceptance and extent every year. Latterly Messrs Elgin & Gilchrist of Glasgow have been supplying these veneers, and it only remains that the public in this country should be made acquainted with this new style of decorative art, to ensure its successful application to our homes and furniture.

Let me sum up.

On the important points of water and drainage brought forward in this lecture, I desire to note the following short lessons :—

1. Never use water for drinking and cooking purposes which has lain stagnant in cisterns or vessels.

2. See that the cistern is cleaned out every month or two, Probably this may be done by water inspectors in course of time, but householders should do it now.

3. See that all connection between the cistern and the drain is cut off, and that the waste goes to the outside of the house.

4. Attend to all closets and sinks, so that they shall be cleanly and sweet. If not there is something wrong.

5. Ventilate private drains by carrying the service pipe to the roof, and open the drain pipe at ground if space available.

6. Trap private drains from the public drains, in order that the gases from the main sewers may not invade the house, and

7. Call on the public authorities—our municipal guardians—to take example by the practice of other large towns and even

small towns, and ventilate the public main sewers by open street ventilating gratings, and thus äerate the main sewers, and consume the sewage gases at the moment of their birth, or even hinder their production and render it impossible for the deadly enemy to exist or be an enemy at all.

As for disinfectants, use but do not abuse them. Their use is for special, local, and temporary purposes,—where illness invades a home, or where sanitary measures cannot be carried out at once. Their abuse is when health measures are neglected, and noxious matters are cloaked over, and closets, sinks, and drains are not attended to, and people trust blindly to them. In such cases they are like the scents and perfumes of former ages, which were used to hide uncleanliness of person, and ill-washed domiciles. Remember that disinfectants do not cure the evil. They simply ward off the attack for the time, and the proper remedy is the removal of the nuisance.

In conclusion, let me state that if another sentence be required to enforce the benefits of health measures, it may be found in the following words, which ought to be household words :—

Pure air, wholesome water, and well ventilated drains reduce sickness and death-rate in any house and in any populous place.

One less death in 1000 of the population in Edinburgh means about 250 fewer deaths in the year, or five less in the week.

Let one of the five during the week be a bread winner for a home, with a probable wage or earnings of £1 per week—£50 per year.

Then remember that this sum derived from capital safely and properly invested would mean at least £1000.

So that the bread winner in his earnings for his home is worth £1000 in cash or invested capital.

During the year, 50 such bread winners saved by sanitary measures would mean £2500 of wages for support of homes, and an invested capital of £50,000.

Were a man a mere machine—a piece of clock-work—costing or worth £1000 and earning £50 a year, how carefully it would be tended and cared for. But man is more than a wage-earning machine. He is the Head of the Home, with all its duties and all its responsibilities.

THE HANDS AND THE FEET.

By Professor Wm. TURNER, M.B., F.R.S.

The subject of this lecture was chosen for me by an accomplished lady, an active member of the Committee of your Society; and as the Committee has approved of the subject, I may conclude that your Society is desirous occasionally to interrupt the ordinary course of lectures, such as you have from time to time had delivered to you—upon either personal health or public health—by lectures upon such branches of anatomical and physiological science as may be regarded of sufficient general interest.

In commencing to say something to you about the hands and the feet, it may be advisable that I should, in the first instance, make one or two prefatory observations on the structure of the body generally. If you look at the Human Body, or at that of any vertebrated animal, a glance will satisfy you that it consists of a trunk surmounted by a head, and of certain more or less elongated parts which are called limbs. Now the trunk and the head are infinitely more important in connection with the general structure of the body than are the limbs, because the trunk and the head contain those organs which are essential to the proper performance of all the functions of life. You cannot remove the head or cut the trunk into pieces without at once putting an end to life; but you may cut off a limb, or you may indeed cut off all the four limbs, without life being put an end to, so that in this way the limbs, you will observe, are quite secondary in their construction and function. They are, as it were, appendages added to the trunk for particular purposes, and as a general rule they are arranged in pairs, two, in man, in the upper part of the body, two in the lower. If you look at animals lower than man you find that the limbs are not situated one above the other, but one pair in front of the other.

Now if you proceed to examine a limb so as to see what it consists of, you will find that it may be divided into three fundamental parts—the girdle, the shaft, and the free terminal end. The girdle of the limb is that part of the organ by means of which it is attached to the trunk. The shaft of the limb is situated between the girdle and the terminal part, and gives length or reach to the limb. The shaft of the upper limb is jointed to the shoulder girdle at the shoulder joint; that of the lower limb to the hip girdle at the hip joint. The shaft itself is divided in the upper limb into an upper arm and a fore-arm, and the elbow is the joint of articulation between them; whilst the shaft of the lower limb consists of the thigh and the leg jointed together at the knee. The free terminal part of the limb is either the hand or the foot as the case may be. Now you may regard the girdle and the shaft of the limb as subsidiary in their function to the hand or the foot. It is the hand or the foot, as the case may be, which gives distinctiveness and specialization, if I may so say, to the limb, whilst the shaft and the girdle are arranged in such a way as to bring the hand or the foot into the best position for performing that use or function which the limb has to perform.

Let us now consider for one moment what are the primary uses of the limbs. And we shall look at them, to begin with, in the human body, in which they are called upper and lower. The primary use of the upper limb in man is to act as an organ for grasping and holding—it is what is technically called the organ of prehension, and it has this name from the power which resides in the hand. But the human upper limb may also have a secondary use, as an organ of progression, that is to say, as an organ by means of which the body can be moved about from place to place. It is only seldom that we use it for this purpose; but we do so when we are swimming, and when we are climbing a tree. The primary use of the fore limb, which is the corresponding limb in the quadruped, is not for prehension, *i.e.*, for grasping or holding, but for support and progression, and you find this limb variously modified in different animals, in order that it may be adapted for enabling them to move about from place to place. Secondarily, however, it can be employed by some animals for purposes of

prehension, thus apes can hold objects with the fore limb, and so also can a squirrel; whilst in such animals as the cat or the lion the fore limbs are used for striking its prey, and even for holding it between its fore paws.

Let us now look at the lower limbs in man, the primary use of which is entirely different from that of his upper limbs, for they are organs of support and progression, *i.e.*, the organs on which he stands, and which are put in action when he wishes to move about from place to place. Secondarily, undoubtedly the lower limbs can be used as organs of prehension, because we can grasp objects with the toes, but this again is an entirely exceptional occurrence. The same primary function of support or progression applies also to the hind limb of quadrupeds; but there are certain animals which can use their hind limbs as organs of prehension, and the most notable of these are the monkeys and those large apes like the gorilla, orang, and chimpanzee, which from a general resemblance in the form and structure of the body to man are called anthropoid or man-like.

Now I have told you that the hand or the foot is the free, distal, or terminal part of the limb, upper or lower, fore or hind, as the case may be, and we should in the next instance consider what is meant by the hand and by the foot. If this consideration were to be limited to what we see in our own bodies, there would be no difficulty in framing a simple definition of these terms. But it is impossible for us in the study of the structure of man to dissociate it from that of other vertebrates. Man in his structure is not to be regarded as a thing apart, but must be studied along with those animals which in their bodily organisation most closely resemble him, so that we cannot say that the hand is exclusively human any more than that the foot is exclusively human. Properly to realise what these terms signify, we should look at them from two points of view: either with reference to their construction, that is to say, what they consist of, and how their constituent parts are put together, and that is their anatomy; or with reference to the use or function to which they are put, and that is their physiology. Anatomically speaking, we may say that the hand is the free terminal part of the upper limb in man, or of the fore limb in a quadruped in which certain bones, joints,

muscles, and other soft parts, are arranged with reference to each other in a particular way, altogether irrespective of the function which they may have to perform. Also, we may say that the foot, anatomically speaking, is the free terminal part of the lower limb in man, or of the hind limb in a quadruped, in which certain bones, joints, and muscles, and other soft parts, are arranged in a particular way without any reference whatsoever to the use to which the limb may be put. But speaking as a physiologist, one would say that the hand is the free terminal part of a limb which is used for the purposes of prehension, and that the foot is the free terminal part of a limb which is used for purposes of support and progression, quite irrespective of the bones, joints, muscles, and other soft parts which enter respectively into their construction.

If I were to treat the subject anatomically, I should have to trace the various modifications which the bones, joints, and soft parts exhibit in man and different animals both in the hand and foot. I should have to point out to you how, starting with five digits as the maximum number in the hand and foot of man and various quadrupeds, one may, by the disappearance of one digit or another, at last reach that stage of structural simplicity where only a single digit exists, as in the horse and other solipeds. And further, one might indulge in speculations as to how a quadruped which at the present epoch has only a single digit, may have been derived by descent from one which at a former epoch had possessed two or even three toes.

But I think, perhaps, that addressing, as I am now doing, a general audience—one which, though not strictly scientific, is still desirous of knowing something about anatomical and physiological science—it may be better that I should look at this subject more from the physiological than from the anatomical point of view. And as the time at our disposal is limited, we will specially concentrate our attention on the human hand.

The human Hand is the highest type of hand. Now let us think for one moment of some of the things that have been done by the hand of man when inspired, and guided by an efficient brain and intelligent mind. It has built the Pyramids of Egypt in all their symmetry and massiveness; it has produced in metal

filagree work, and in thread lace work which rival in their delicacy and beauty the fineness of gossamer; it has modelled in the marble of the Venus of Milo a figure which in its form and proportion embodies the highest type of female grace and beauty; it has depicted on canvas in the great Sistine Madonna a countenance filled with the mystery of humanity. When we contemplate work so wide in its range and so varied in its character, we are naturally tempted to ask what is the construction and mechanism of the human hand which enables it to be applied so effectively for the discharge of work which in one direction requires the exercise of great strength and freedom of movement, and in the other delicacy and lightness of touch, combined with movements so fine as to be almost imperceptible.

The human hand consists primarily of three parts—one called the wrist, another the palm, and a third composed of the digits, which are five in number, so that the hand in man is pentadactylous. Five is the highest number of digits which you will find either in man or any existing mammal as the normal development, although rudimentary supplementary digits are occasionally produced.

To each of these digits in the human hand a special name is given. The first and most important is the thumb. It is the shortest of all the digits, but it is also the thickest, the strongest, and the most active. The Romans called it by the name of *pollex*, from the verb *polleo*, which signifies power. Another name which has also been given to it by Latin writers is that of *digitus doctus*, the instructed or skilful digit, expressing by this term how much the skill of the hand depends on the thumb. But the power of the thumb is also recognised in familiar speech. We say, for example, that one man has another man "under his thumb," that is, completely under his control. I need scarcely tell you of the well-known Scottish proverb, "Ye needna fash yer thoom;" it is not worth while troubling yourself to exercise the power of your thumb to do it. But perhaps the most exalted conception of the thumb is found in the idea of creation which prevails among the Esquimaux, who, it is said, believe that the woman arose out of the thumb of the man. But even the thumb, like all great things or persons in power, is at

times subject to the language of depreciation. Thus one may hear it said of a person who is clumsy in the use of his hands, and not dexterous in performing mechanical work, "Oh, his fingers are all thumbs."

Next to the thumb is the index finger, that is to say, the finger that we point with or beckon with, and this is the most moveable of all the fingers, which is the reason why it is used as the index or beckoner. I shall have to show you as we go on the anatomical reason why we use it as a pointer. Then the next is the middle finger, which is the longest of all the digits, and from its length it is a very important member of the hand. Next in order is the finger that we are all familiar with as the ring finger, around which custom prescribes that on the left hand of a married woman—though not of a man—the wedding ring should be worn. This custom is of great antiquity, and goes back to classical times. The Romans called this finger the *digitus annularis*, and it was selected for the ring, because it was believed that a nerve passed directly from this finger on the left hand to the heart. I need scarcely tell you that no such nerve has ever been seen, but the belief seems to have initiated the practice. Neither the ring nor the index finger is so long as the middle digit. In some persons the ring finger is longer than the index, in others the opposite prevails, and in others again they are of the same length. Even the two hands of the same person may differ in the relative length of the two digits. Last of all is the little finger, which is the shortest of the fingers, and the least important of all the digits.

Now let us look at some of the most striking properties of the hand. It possesses flexibility, elasticity, mobility, and sensitiveness of touch.

Its flexibility and elasticity are due to the number of bones and joints which it contains. The bones of the hand are twenty-seven in number, and are arranged in three groups—bones of the wrist, of the palm, and of the digits; eight small or short bones enter into the formation of the wrist, and are called carpal bones; five elongated bones lie in the palm, and are called metacarpal bones; whilst fourteen bones enter into the formation of the digits, viz., three in each finger and two only in the thumb. These bones are called phalanges, because they are arranged

in rows like the soldiers in a Greek phalanx. If we compare the skeleton of the hand with that of the shaft and girdle of the limb we shall see that the number of bones in the hand, limited though it is in size, far exceeds those which we have in the other divisions of the limb. Thus in the girdle there are only two bones, the shoulder blade (scapula), and the collar bone (clavicle), and in the shaft, notwithstanding its great length, there are only three bones, one in the upper arm (humerus), two in the fore-arm (radius and ulna). The great number of bones in the hand necessarily leads to the formation of numerous joints, of which there are between thirty and forty.

Next as to the elasticity. Wherever you have a moveable joint there you have material which serves elastic purposes, and so with the multiplication of joints you have necessarily a multiplication of elastic structures, because every one of the bones of the hand at the surface where it is jointed to another bone, is covered by a layer of elastic material which we call cartilage, and these elastic cartilages serve as buffers to break the violence of a shock; and we know perfectly well that the hand is a region of the body which in the various uses that it is put to is very liable indeed to receive shocks, and sometimes of a very severe character. You give a blow with some force, striking a hard body, and necessarily a certain shock is imparted to the limb, but that shock is broken from the number of joints and the plates of this elastic cartilaginous material.

Let us look in the next instance at the mobility of the hand, clearly a very important factor to be taken into consideration. The mobility of the hand is provided for in part by the number of bones entering into its formation, in part by the forms of the surfaces of the joints, and in part by the numerous muscles that are attached to its different bones. These muscles are in some instances of considerable length, and pass from the fore-arm to the hand. They possess long tendons or sinews, which as they pass either in front of or behind the wrist are retained in their place by strong ligaments. Those behind the wrist go to the back of the hand, and are called the extensor tendons; those in front of the wrist enter the palm, and are named the flexor tendons. Others of the muscles are short and confined to the hand itself; one

group forms the eminence known as the ball of the thumb, the other the eminence of the little finger.

In the study of the movements of the hand we have to direct our attention partly to those movements as a whole, and partly to the movements of the individual digits. The movements of the entire hand take place at the wrist, that is, at the place where the carpal bones are jointed to the lower end of the bones of the fore-arm. At this joint you can move the entire hand forward for a very considerable distance towards the front of the fore-arm; you can also straighten the hand out until it is in line with the fore-arm, and then you can bend it backwards, and the path of movement which the hand takes in these directions is in the antero-posterior plane. But you can also move the hand from side to side in the transverse plane, so as to bring either the thumb or the little finger into proximity with the corresponding side of the fore-arm. But further, these various movements may be combined or continued into each other, so as to make the path of movement a cone, the apex of which is at the wrist. Hence the range of movement at the wrist joint is very extensive, and you have but to consider the various things that you do with the hand in connection with its movements as a whole to realise how important this freedom of movement is.

But along with the movements at the wrist joint we should look at the mode in which the hand moves in conjunction with that bone which is called the radius, or outer bone of the fore-arm. The radius rolls about the ulna or inner bone of the fore-arm in the movements of what are technically called pronation and supination. When I present my hand to you so that the palm is directed upwards, both the hand and fore-arm are in the position of supination; and if I then move my hand so that the palm is directed downwards, both hand and fore-arm are thrown into the prone position. Now observe that these movements do not take place at the wrist joint, but between the two bones of the fore-arm itself. And as the radius is the bone which moves, and as the hand is jointed at the wrist principally to the radius, the movements of the radius also produce those of the hand. These movements are of the utmost importance in connection with much that the hand has to do. I

may instance, as examples, the acts of writing, painting, or drawing, in which there are not only slight movements of the thumb and fingers between which the pen or pencil is held, but gentle movements at the wrist, associated with a small extent of pronation and supination between the bones of the fore-arm. And observe what we always do with the fore-arm, when we are about to use it and the hand in performing these prone and supine movements. We semiflex the elbow, because then a hollow at the upper end of the radius is brought into more precise apposition with an eminence on the lower end of the bone of the upper arm, that is, the humerus, and in this way provision is made, by giving a definite surface to the radius on which it can move, for pronation and supination to take place with the utmost precision.

In the next place, we will look at the movements of the individual digits, which are also of very great importance. We must give the first place to the movements of the thumb, because this, as we have stated, is the most important digit. Let us consider for one moment what the thumb can do. Look at it in our own hands, and we shall see that we can bend the thumb, or straighten it, or draw it away from the index finger, or approximate it to the same finger ; and further, we can throw the thumb across the front of the palm. This last movement is technically known as the movement of opposition, in which we oppose the thumb to the other digits, and can touch with the tip of the thumb the tip of each finger, or indeed any part of the palmar surface of any one of the fingers, or a considerable part of the palm itself. The movement of the thumb in opposition to the fingers is of the utmost importance, for it is that which more especially gives power to the human hand, and enables it to act so admirably as an organ for grasping or holding. If we want to take hold of any large object, we encircle it not only with our fingers, but with the thumb, whilst a smaller object is held between the thumb and one of the fingers, usually the index or middle. We have, therefore, a much firmer grasp than if we were to encircle it simply with our fingers, or hold it between any two of them.

The thumb, therefore, in addition to the muscles which can bend and straighten it, can draw it from or to the index

finger, has an additional muscle, the *opponens*, especially developed for performing the movement of opposition. It is attached to the longest of all the bones of the thumb, viz., the metacarpal bone, so that it exercises power over the whole digit, and throws it across the surface of the palm. But this extensive movement could not be carried out unless the joints of the thumb were so constructed as to admit of it. Accordingly we find that the joint between the metacarpal bone of the thumb and its corresponding carpal bone is so constructed as to allow of considerable movement. In this respect the thumb differs materially from the fingers, the metacarpal bones of which have scarcely any movement on their carpal bones. There is also another arrangement which restricts the movements of the fingers but not that of the thumb. For the four fingers are all tied together by a ligamentous band which is called the great transverse ligament of the hand, so that there is only a very limited power of separating them from each other; but this ligament does not pass to the thumb. If it had done so, then the thumb would have been tied to the index finger, and necessarily its freedom and range of movement would have been much more limited. But whilst we speak of the opposition of the thumb we must not limit our conception of the movement of opposition as a whole simply to the movement of the thumb. The other digits participate also to some extent. In this place I shall refer to the little finger, to the metacarpal bone of which an *opponens* muscle, corresponding to the *opponens* muscle of the thumb, is attached. This muscle possesses a certain power of throwing the little finger forward. Now when both the thumb and the little finger are thrown forward by the action of their respective *opponens* muscles, observe what you do with the hand. You hollow the palm into a cup, and this cup is named after the old Greek cynical philosopher, the cup of Diogenes. Many of you doubtless recollect the story how he used to employ a wooden cup as a drinking vessel; but one day he discovered that he could use the palm of his hand for this purpose, and so he threw the cup away as a superfluity.

In the next place, we will consider the movements of the fingers. We can bend or throw them forwards towards the palm.

Then we can straighten and throw them into a line with the palm, and even bend them slightly backwards. But, further, we can draw the fingers apart from each other; and when we combine this movement with the separation of the thumb from the index finger, we broaden the hand. Then we can approximate the fingers so that they come in contact with each other by their sides. For the purpose of performing these various movements there are appropriate muscles. Situated on the front of the fore arm are two muscles called the superficial and deep flexors or bending muscles. They give rise to eight tendons which pass in front of the wrist to the palm. To each finger two tendons proceed, one to be attached to the second, the other to the third phalangeal bone. In the palm itself are four small muscles, which from their worm-like form are called lumbricals, and these end on the back of the first phalanx of their respective fingers; so that each phalangeal bone has a flexor muscle connected with it. By the action of these muscles not only can each phalanx be bent on its neighbour, but the entire finger on the surface of the palm. This it is undoubtedly that gives such great power in seizing an object with the fingers, for we can make them assume the form of a series of hooks by means of one and all of which objects can be grasped.

When you bend the fingers and at the same time keep the last phalanx straightened on the second, you will see that the tips of all the fingers are directed to the ball of the thumb, so that the fingers cross obliquely in front of the palm and are in this way approximated to the thumb. Now this is a very interesting movement, as by it the entire series of fingers become opposed to the thumb, and as we have already seen that the thumb by muscular action can be opposed to the fingers, the thumb digit and finger digits meet each other. In this manner the hand becomes a much more thorough instrument for grasping and holding than would have been the case if the direction of the movement of the fingers had not been towards the thumb.

The conversion of the hand into a fist or instrument for striking a blow is produced by bending the fingers tightly on the palm, and by bending the thumb on the fingers.

Now let us look at that opposite action which is called exten-

sion or straightening of the fingers. The extensor muscles which are concerned in producing it are situated on the back of the fore-arm, and form long tendons or sinews which go to the back of the fingers, and end in the back of the second and the third phalanges. If we examine these tendons as they lie on the back of the hand, we shall find an anatomical explanation of the reason why the index finger is so free in its movements that we naturally use it as a pointer or beckoner. The two extensor tendons which go to it, though connected with each other, are not connected with the tendons passing to any of the other fingers, so that they act on it without influencing the movements of any of the other fingers. Hence its action is perfectly independent. But if we look at the extensor tendons which go to the middle, the ring, and the little fingers, for the purpose of straightening them, we shall find that they do not have a similar independent course, for they are all tied together on the back of the hand by distinct bands, which pass from the ring finger on the one side to the middle, and on the other side to the little finger. Hence you cannot work them in the same independent way that you can work the index digit, for in attempting to move one, the others are also acted on. Every one who has learnt to play a musical instrument knows perfectly well that he can strike a note with far more certainty with the index than with the other fingers, and that of all the digits the ring finger is the one over which it is most difficult to acquire control and mastery.

I will now give you an illustration of this which may perhaps amuse some of you, and relieve the tedium of the detail of anatomical structure which I have been giving you. Here are the five digits in each of my two hands. Now I am going to give to these digits names. I shall call my two thumbs father and son, and my two index fingers mother and daughter, my two little fingers brother and sister, and appropriately enough, my two ring fingers husband and wife. But I have got the middle fingers to give a name to, and I shall choose a name for them from that Parliament House in which you, Sir (the Chairman), are so distinguished an ornament. I shall select an eminent judge skilled in the law of husband and wife, namely, Lord Fraser. My two middle fingers, therefore, represent Lord Fraser. Now see what I am

going to do with them. I place the two thumbs in contact with each other at their tips, also the two indices, the two rings, and the two little fingers, and I bend the middle fingers down between the palms of my two hands. Then observe father and son I can part, mother and daughter I can part, brother and sister I can part, but husband and wife cannot be parted until Lord Fraser becomes visible. Put him on the bench, raise the middle fingers up from between the palms, and then the divorce of husband and wife—the separation of the ring fingers can be at once effected.

The widening of the hand by the separation of the fingers, and the bringing the fingers again into contact with each other are due to the action of muscles occupying the intervals between the metacarpal bones of the palm. But these movements can only be done when the fingers are straightened out or extended, not when they are bent on the palm.

The muscles which bend and extend the fingers, although possessing considerable power, have their action limited by certain conditions. Thus if we bend the wrist by the action of its proper flexors, we at the same time relax the flexors of the fingers, and if we then put the latter in action, we shall find that we cannot make a "fist," or forcibly bend the fingers on the palm, for from the position in which the flexor muscles have been placed by the bending of the wrist they have become so lax that their fullest action is not sufficient to tighten their tendons. Similarly, when the hand is bent backwards, it is almost impossible to straighten the fingers, as their extensor muscles are so relaxed that their power of extension is diminished.

Now I spoke of another important property of the hand, viz., its sensitiveness to touch. Let us look at the skin of the palm of the human hand, and we shall find that it has several very interesting characteristics. In the first place there are no hairs either on the palm or on the palmar surface of the digits. Secondly, we should notice its comparative smoothness and its tension. You may press upon it with your fingers but the skin of the palm does not slip to and fro, whereas the skin ot the back of the hand, or on the body generally, can be moved about with ease. This tension is due to the skin being tied to the subjacent strong fascia by a number of intermediate bands. Through this tension

of the skin it can be accurately adapted to the surface of any object which is held in the hand, such as the globe or sphere that I am now grasping, and as the skin is the great sensory surface of the hand, the character and properties of objects, so far as they can be determined by the sense of touch, can be ascertained.

But there is another very interesting arrangement connected with the skin of the palm of the hand which I wish to refer to—that is, the presence of certain grooves on its surface. These grooves are of much interest in connection with the mobility of the hand, of which I have already spoken. For instance, the great groove that curves along the root of the thumb marks the movement of the thumb in connection with opposition, and where this groove is well displayed you may be perfectly sure that the thumb has a great range of movement. Two other grooves run across the palm of the hand more or less completely from one margin to another, beginning about the root of the index finger, and I wish you to note the direction which they take. They are inclined obliquely from the outer to the inner border of the palm, and there is no difficulty in seeing this in your own hands. They are grooves which mark the line of flexion or bending of the fingers on the palm, and their oblique direction indicates that the path of movement of the fingers in the act of flexion is obliquely towards the thumb. Another groove never so distinctly marked, as those I have just referred to, runs from about the root of the little finger towards the wrist. In some hands you will scarcely see it, but in others it is visible. It marks that movement of the little finger in opposition to the thumb, of which I have already spoken (p. 134). There are other faintly marked longitudinal grooves which extend from the roots of the fingers towards the wrist, which are to be associated with the movements of separation and approximation of the fingers referred to on page 137, and on the palmar surface both of the fingers and thumb are grooves, some of which are transverse and others oblique, which mark the lines of bending of the phalangeal joints of these digits. The signification of these grooves is to express the direction of movement of the various digits.

But there are persons who will tell you that these grooves

have a much deeper signification. If those persons were merely those somewhat swarthy-skinned, black-eyed, black-haired women who go about in the garb of gypsies telling fortunes, I should not refer to them now. But men purporting to be scientific have written books on the subject, which they dignify by the name of Cheiromancy or the Science of Palmistry. They state that by a proper study of these grooves and of the intermediate eminences, they can not only determine the character of people, but also foretell what will happen to them in the future. The groove which curves round the root of the thumb and marks the movement of opposition of the thumb they speak of as the line of life. The two grooves that run across the palm, which mark the direction of flexion of the fingers, they call the one the line of the head, and the other the line of the heart. The fine groove that indicates the movement of opposition of the little finger is called the line of the liver, and the groove which passes down from the middle finger to the wrist, and which is associated with the approximation of the fingers, is called the line of fate. Then the various eminences which lie between these grooves have all received names culled from the old heathen mythology. The eminence formed by the muscles of the ball of the thumb is called "the Mount of Venus," and that which marks the position of certain muscles of the little finger is called "the Mount of Mars" in one part, and in another "the Mount of the Moon," whilst the eminences at the roots of the fingers are named after Jupiter, Saturn, Apollo, and Mercury. But the study of the structure and movements of the hand at once dispels the cloud of mystery and superstition which some have endeavoured to throw over these markings, and resolves them into arrangements which are conditioned by the structural and functional relations of the organ in which they are found.

In addition to the strong grooves just described, a number of finer lines and grooves are present on the skin of the hand, more especially at the tips of the fingers and thumb, which are more distinctly seen with the aid of a simple magnifying glass. They express the position of what are called the papillæ of the skin. But these papillæ do not come to the actual surface, for they are all protected by an important envelope, which lies on the surface

of the skin, and is known by the name of the cuticle, or epidermis, or scarf skin. The cuticle consists of a very large number of small microscopic objects, technically called cells, which are arranged in numerous layers; those next the surface are tough and horny, but those more deeply placed are soft and contain the colouring matter of the skin. The cuticle is quite insensible and without blood-vessels, so that you may prick or cut it without giving pain or shedding blood. Here is a good specimen which consists of the cuticle removed from the human hand, forming, as it were, a natural glove. And this cuticle has no sensibility whatsoever.

The sensibility of the skin resides in that structure which is situated directly subjacent to the cuticle, that is to say, in the cutis or true skin which is composed of the elongated structures called papillæ. These papillæ contain both nerves and blood-vessels, and when cut they both bleed and give much pain. For the nerves which go to the hand terminate in these papillæ, in very remarkable structures, technically known as the touch corpuscles in the papillæ of the cutis. When you take and grasp an object in the hand it is brought, of course, into direct contact with the insensitive cuticle, but by slight pressure upon the object the nerves which end in these touch corpuscles in the papillæ of the cutis are, as it were, impressed by this object, and impulses are generated in the nerve fibres that end in the touch corpuscles, which are transmitted to the brain of the person holding the object, so as to induce in it effects which enable him to determine the form or the nature of the object—whether it be rough or smooth, sharp or blunt, cold or hot. In this way one is enabled to make out the various characteristics of material objects so far as they can be determined by the sense of touch. The most sensitive parts of the hand are the tips of the fingers and of the thumb. But if these very sensitive papillæ of the cutis were not covered over by the thickness of cuticle it would be entirely impossible for us to touch anything. The cutis is itself so sensitive that it is impossible to touch anything directly with it without occasioning very great pain. It requires, therefore, to be covered by a substance which is insensitive, so that we may use our hands as organs of touch. Persons who are accustomed to hard

manual labour, or to handle very hot objects, find that the cuticle undergoes a natural thickening. We all know the expression, "hard-handed sons of toil," which is not figurative, but expresses an actual anatomical condition. Why the sons of toil are hard handed is because their cuticle is very much thicker and tougher than it is in the hands of persons who have not to employ themselves in hard manual labour. This thickening is for protective purposes, and enables the skin to be used for the work which it has to do, without damage to the sensitive parts which lie beneath. The thickened cuticle, without doubt, diminishes the sensitiveness of the hand, but if a person ceases to use his hand in hard labour, then as the layers of the cuticle which lie next the surface are constantly being shed, it again becomes thinner and the natural sensitiveness of the hand is restored.

I had intended to have said something to you respecting the hand of the ape as compared with the hand of man, but as time is running on my remarks on this matter must necessarily be brief. In the hand of the ape the thumb is much smaller in size, relatively speaking, than the fingers. The ape therefore does not possess such power of opposition with its thumb as in the human hand, and therefore the ape's hand is not so efficient a grasping instrument. For example, in this skeleton of the hand of an ape, namely the orang, the thumb is a feeble digit as compared with the fingers, which are not only very much longer, but also stronger; and it is quite clear that this ape must use its fingers much more than its thumb in performing the uses to which its hand is put. If you take an opportunity of seeing, either in a zoological garden or in a travelling menagerie, the way in which apes use their hands you will find that they do not use the thumb to the same extent that a man does. When they grasp an object they encircle it with their long fingers, which are admirably adapted for seizing hold of and embracing the cylindrical boughs of the trees, which are the natural home of the ape. Further, the entire upper limb of the ape is both longer and more powerful than the lower limb, and when suspended by its hands it can swing itself from one bough of a tree to another, or can support its body with the knuckles resting upon the ground. This limb therefore is also used by the ape for progression, and the hand is a hand-foot or manuped.

But the skin of the palm of the ape's hand possesses grooves on the surface which mark the direction of movement of its digits. In the palm of the hand of the gorilla a groove corresponding to the upper of the two oblique grooves in the human palm crosses the palm from about the root of the index finger to the opposite side of the hand; its direction is slightly oblique, but without the marked obliquity of the corresponding groove in the human palm. A little below it is a second groove almost transverse in direction, whilst much nearer the wrist is a third groove running nearly in a transverse line. The curved groove which corresponds to the root of the thumb is much less individualized than in the human hand. In the palm of the chimpanzee the two grooves which cross it are almost transverse in direction, and the groove which runs along the root of the thumb is feeble.

The almost transverse direction of the two palmar grooves indicates that the fingers, when bent, are not inclined obliquely to the thumb to the same extent as in the human hand. The comparative feebleness of the thumb and of its movements are also expressed by the feebleness of the curved groove along its root. In these and other apes, therefore, the power of opposing both the thumb to the fingers and the fingers to the thumb is much less perfect than in the human hand, and the thumb does not play the same part in prehension. An ape grasps an object, like the branch of a tree, by enclosing it with its comparatively long fingers, which hook around it, and the movements of which are more adapted for grasping a cylinder than a sphere.

I wanted to have said something to you about the Foot in man, in order to show how it is adapted for the purposes that it has to perform, as an instrument of support and progression, but the time at my disposal will only enable me briefly to direct your attention to some of its principal characters. The human foot forms a base or pedestal to the very important column formed by the lower limb. And it is so constructed that it can support not only the lower limb but the weight of the entire body, either in the act of standing or of walking. The human foot is as characteristic of man as the human hand, and its most distinctive feature is the great toe. The great toe has the distinguishing

name of *hallux*, and the little toe is specially so called from its small size, but they are the only digits in the foot which have distinctive names. The great toe is by far the most massive in size and proportions. It lies parallel to the other toes, is continuous with the inner border of the foot, and does not project at an angle as does the thumb from the side of the hand. It also lies in the principal axis of movement of the foot. It is often the longest of the toes, though sculptors usually represent the second toe as the longest.

The foot in its general constitution corresponds in many respects with the hand. It has, however, only twenty-six instead of twenty-seven bones, which are arranged in three groups, viz.: the bones of the ankle or tarsus, seven in number; the five bones which form a large part of the sole or metatarsus, and the fourteen phalangeal bones of the toes. Like the hand it has five digits, and is pentadactylous.

The foot is situated at a right angle to the leg, and it is so arranged that the sole of the foot is directed towards the ground, so that the human foot is a plantigrade foot. But as the sole is not flat, but arched, it touches the ground only at certain points, viz., at the heel behind and at the heads of the metatarsal bones, more especially that of the great toe in front, and at these points the skin is thickly padded with a cushion of fat so as to diminish the pressure. In some persons the sole is flat, so that the greater part of its surface rests on the ground, but this is a deformed condition of the human foot, and one which diminishes its spring and usefulness. The arch of the foot extends partly from side to side, but much more markedly from toes to heel, so as to form a very considerable arch, which is always better seen on the inside than on the outside of the foot. Most of you doubtless know the expression, "a high instep." Many people think that this is a mark of high breeding, and undoubtedly it marks a well-formed and thoroughly useful foot.

The foot, like the hand, possesses flexibility, elasticity, mobility, and sensitiveness to touch. Its elasticity is one of its most important properties, for the foot even more than the hand requires to be elastic. It acquires a certain measure of elasticity from the number of bones and joints which it contains, just as the hand

does. But its arched construction adds most materially to its elasticity. The elasticity is required for two reasons, partly to aid in supporting weight, and partly to break shock.

When we are standing erect either on one foot or both feet the superincumbent weight of the body and lower limb is transmitted downwards through the larger bone of the leg (tibia) to the dice-shaped bone (astragalus), which is the highest bone of the ankle. From the astragalus the weight is distributed in two directions: directly downwards through the heel bone (os calcis) to the tip of the heel behind, and downwards and forwards through the bones of the inner border of the foot to the great toe in front. Now the principal arch of the foot, as I have already stated, extends longitudinally from the heel to the great toe, and the weight is therefore largely sustained by that arch, which is strengthened by strong ligaments passing between the different bones, and by some of the tendons which pass from the bones of the leg to the tarsal bones, and which act as slings. The prominence of the heel bone, which forms the pier on which the foot rests behind, is situated a little behind the centre of gravity of the leg and behind the axis of movement of the ankle; whereas in the fashionable ladies' boot of the present day, the high and narrow heel is moved forward so as to underlie the arch of the foot instead of being in its proper place below the pier of the arch itself. From the height and wrong position of the heel of the foot, a great strain is thrown upon the joints of the foot, too large a proportion of the weight of the body is thrown forward on the toes, and the usefulness of the limb is impaired.

The foot is far more liable to concussion than the hand. It is only occasionally that we drive a blow at a hard object with the hand, but we are constantly striking the hard ground with the feet, when we are walking, running, and leaping. In order to preserve the body from concussion it is necessary that those parts of the lower limbs which come in contact with the ground should have such an elastic construction as I have been referring to. In leaping from a height it is important to alight on the toes, and not on the heels. If the heel first comes to the ground, then the concussion is at once transmitted through the bones of the leg and thigh to the trunk and head, and great shock and injury may

accrue. But if the toes are the first to touch the ground the concussion is transmitted through the joints of the toes and of the tarsus, and is broken by the elastic cartilages and elastic ligaments which enter into their construction.

The mobility of the foot is to be considered both with reference to the entire foot and to the toes. The entire foot moves at the ankle joint in flexion and extension. We extend the foot in the act of walking by the action of the great muscles of the calf of the leg, which are attached by a strong tendon, named after the Greek hero Achilles, into the prominence of the heel. This movement is necessary in order to "take a step," and it is by it that the toes are pressed on the ground and the body is propelled forwards. The lateral movement at the ankle joint is almost inappreciable, as it is necessary that the joint should be fixed when we are standing in order that the erect attitude may be preserved.

The movements of the toes are not so interesting as those of the fingers and thumb, because they are far more limited. The great toe has, however, a considerable range of movement, though not so great as the thumb. It is tied to the other toes by a transverse ligament comparable to that which ties together the fingers, but which does not reach the thumb, and therefore its movements are necessarily very considerably restricted. Still we can bend the great toe and straighten it, and draw it away from and bring it back to the second toe. Similar movements, though even more restricted, can be performed by the other toes. By the approximation of the great to the second toe objects can be grasped firmly between them, but this is quite different from the movement of opposition of the thumb. Still persons who have had the misfortune to be born without arms or hands, or those who have lost them by accident in early life, can train themselves to hold and work with a pen, pencil, and even a knife or razor held between the sides of the great and second toes.

The skin of the sole of the human foot is marked by grooves which indicate the direction of movement of the toes, but these grooves are not so numerous or so distinct as in the hand, for the movements of the toes are neither so extensive nor so complicated as those of the thumb and fingers. To some slight extent there is a movement of the phalanges of the great toe towards the smaller

toes, and of these again towards the great toe, as is shown by the oblique direction of the grooves on the skin of the toes themselves. On the sole proper there are two somewhat oblique grooves near the inner border of the foot, at the root of the great toe, which indicate the direction in which the great toe bends at the joint between its phalanx and its metatarsal bone. Sometimes a longitudinal groove may be seen extending backwards towards the heel and beginning near the cleft between the great and second toes. This groove indicates the movements of the great toe in the transverse plane of the foot, as we separate it from or approximate it to the second toe. It is probable that persons who do not clothe the feet with shoes, and in whom therefore the movements of the toes are much more free, may have the grooves on the sole more distinctly marked, than is the case where the toes have been hampered in their movements and too often deformed through wearing tight and ill-constructed shoes.*

Let us now glance at the foot of the ape, in which we shall see that the great toe is set at an angle to the inner border of the foot. It is usually more massive than any of the other toes, but it is much shorter, and its general appearance is more like a thumb than a great toe. The skin of the sole in the gorilla possesses a strong curved groove coursing round the root of the great toe and running backwards towards the heel, which expresses the direction of the movement of opposition of which this digit is capable. In front of this groove are two well-marked grooves on the sole, which run very obliquely from near the root of the second toe to the outer border of the foot. Their obliquity indicates that the four outer toes, when bent, incline towards the great toe, and thus, like the fingers in the human hand, they contribute to the efficiency of the foot as a grasping instrument. A somewhat similar arrangement of grooves exists in the skin of the sole of the chimpanzee. So that in these anthropoid apes the prehensile character of the foot can be determined by an inspection of the skin of the sole, as well as by the study of the bones, joints, and muscles. The foot of the ape, physiologically speaking, is a foot-

* I have not thought it necessary to go into the deformities of the foot produced in this way, as this subject was treated by Dr Cunningham in his Lecture on "The Human Body," delivered in 1881 to this Society.

hand, it is pedimanous, *i.e.*, it can be used both for support, progression, and for prehension, whilst anatomically it is a foot, for it consists of bones and other parts similar to those present in the human foot. The power possessed by apes of using both hands and feet as grasping instruments has induced naturalists to say that they are quadrumanous.

A few words may now be said on the sensibility of the foot, because the foot is sensitive to impressions of touch, though not quite so sensitive as the hand. For the cuticle of the sole is always thicker than that of the palm, and this interferes, to some extent, with the transmission of impressions to the nerves which end in the papillæ of the true skin. If you were to strip off the cuticle of the foot, you would find it to form, as it were, a natural slipper similar to the natural glove I have already spoken of in the hand, and you would then see how much thicker the cuticle of the foot is than that of the hand, because the foot being used for support and progression, and subjected, therefore, to frequent pressure, requires a thicker cuticle in order that the highly sensitive nerve papillæ which are found in its trne skin may be protected from injury. This sensitiveness of the skin of the foot is of great importance to us, because it enables us to determine the nature of the surface on which we walk. If the foot were not sensitive we could not tell the form or estimate the resistance of the surface on which the feet were placed in the act of progression.

A very interesting lesson may be learnt by watching the movements of a person who has no sensation in his lower limbs. For you sometimes find people who have a paralysis of sensation, and if you watch them as they walk, you will find that they look constantly at their feet, for through the want of sensibility they cannot estimate where their feet are placed. Persons so affected have to call in the aid of another sense, viz., that of sight, in order to enable them to tell what they are walking on. Should they be required to walk in the dark then they are helpless, because they cannot then employ the sense of sight to supply the place of that which they have unfortunately lost, namely, the sensibility of the skin of the soles of the feet.

From this rapid and necessarily imperfect sketch you will, I

think, have seen that in man the limbs are specialized for the performance of distinct and definite duties, and each limb is constructed so as to be adapted most efficiently to carry on the particular work which it has to do. The lower limb can be straightened at both the hip and the knee joints so as to be brought below the body, and the sole of the foot can then be so planted on the ground that we can stand either on one foot or on both feet. The spine can be elevated so that its axis becomes vertical, and the body assumes the erect attitude—that attitude which is characteristic of man. The head is balanced on the summit of the spine, and can be moved to and fro, so that the eyes exercise a wide range of vision. Within the head is a brain, far more highly organised than is possessed by any animal. The upper limbs, liberated from the necessity of acting as organs of support and progression, can minister to an intelligent mind, and through their strength and adaptability, can enable man to fulfil the great command which was imposed upon him in the beginning, to "go forth over the earth and subdue it, and to have dominion over the fish of the sea, over the fowl of the air, and over every living thing that moveth upon the earth."

THE DIFFICULTIES OF HEALTH REFORMERS.

PART I.

By H. H. ALMOND, M.A., Oxon.,
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"Difficulties are opportunities" is perhaps the latest addition to the aphorisms of the language. But since the kindness of the Committee has vouchsafed to me the present opportunity, I have felt with increasing and well-nigh overwhelming force that the converse is true, and that opportunities are also difficulties.

The task, indeed, which I have been rash enough to undertake is one which rivals in extent the far-famed unfinished work of Mr Caxton, on the "History of Human Error." Anything like an exhaustive discussion of my subject would involve not only a survey of the whole field of sanitary science, but also the consideration of a vast mass of outlying questions, which are entangled with social arrangements and institutions of every kind.

It has seemed to me, indeed, that the time has come when a new science ought to be formulated, which, after the analogy of the old political economy, should be called hygienic economy. Just as political economy demonstrates how all institutions should be regulated so as to produce the greatest amount of *wealth*, so hygienic economy would demonstrate how they should be regulated with a sole view to *health*. And here lies the root both of error and misapprehension, of error on the part of the investigator, because he is apt to regard the end which he has in view as of inordinate importance in the scale of human good, and of misapprehension on the part of others, because the conclusions arrived at will be continually clashing

with their preconceived notions. And yet this is surely the way in which the goal of truth has in the end always been won. Wealth is not the only good, neither is health. And yet as the one-sided conclusions of the political economist have been productive of vast practical good, though they have had to be balanced by other considerations, so it would clear, though it might startle men's minds, if for a time they could be led to contemplate all their institutions and habits in the light of hygienic economy, leaving the balance to be struck afterwards, as in the other case. I wish, therefore, to be understood to-night as rather putting the case of an advocate than presuming to give judicial decisions, for which I am unqualified, and which indeed would be premature. Health reformers—or, if you will let me use the word, Hygienic Economists—have an uphill battle to fight. Their science is in the condition of political economy, when commerce was fettered by restrictions and corrupted by bounties, when parliaments and statesmen ignored the scientifically proved laws of wages and prices, of demand and supply. And yet I venture to prophesy that the most advanced health reformer of the present day will appear to our grandchildren as a very narrow Conservative, even if he stands convicted of some of the blunders inseparable from all enthusiasm and from all search after truth. But let us consider if there is anything in the nature of hygiene to cause it to lag behind in the race of progress.

In the circle of the sciences it occupies the opposite pole to mathematics. So long as the science of mathematics dealt with pure abstractions, she escaped the persecution of bigots and the ridicule of fools. But when she came down and meddled with material things, when she rounded off the flat earth, when she bade the cramped heavens break open to their highest, then the slumbering forces of intolerance awoke, and forewarned her sister sciences that they too must pass through the purgatory of tribulation to the paradise of triumph. Each in her turn has suffered: each has won her way inch by inch. The progress of science is indeed a dark page in human history. The more any discovery has touched the prejudices, the passions, the narrow interests of men, the greater has been the suffering, the harder

the fight. But it is a bright page in human history for all who trust that

> "Through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns;"

for all who see, in those who for the love of truth and for the love of men have braved all that men could do or say, a forecast of what humanity may become. They have not fought and suffered in vain. Our battle is practically won along the line. Opinion is well-nigh free. She has claimed and won her rights in the council chambers of nations, in the assembly halls of divines, in the daily speech and writing of men among men.

But—and here is the central difficulty of my subject—action is still fettered. Practice is not yet the necessary consequence of proof, and hygiene deals with action and with practice. She lies, as I said, at the opposite pole from mathematics. She may indeed draw her inspiration from above, but her home and her work are on the ground. There she is omnipotent and irrepressible. Like Socrates she brings down philosophy from heaven to earth, and also like Socrates she turns that philosophy into a weapon of attack against the strongest positions in which human error can entrench itself. Her aims, so vast in their totality, founded as they are on eternal principles of truth, necessitate for their realization a descent into details so petty as to incur the sneer of the apostles of culture, and notions so unconventional as to expose her on every side to the dislike and the derision of the vulgar rich and the vulgar poor.

Whenever she attempts to carry theory into practice she displays a combination of qualities which men in general loath and ridicule. She is meddlesome, prying, lecturing, and newfangled, especially in those matters which men regard as the sphere of custom and common sense, and in which they most pride themselves as being their own masters and taking their own way.

It will, I think, be clear from this why the main difficulties of hygiene are essentially different from those of the other sciences, even those who deal most closely with life. Their difficulties are mainly those of research and discovery. No one, *e.g.*, can doubt that if the problem of producing a cheap and manageable electric

light were solved (or if an electric locomotive were invented, having a distinct balance of advantage over the steam-engine), that the universal adoption of such an improvement would be a mere matter of time, and whatever might have been the case 100 years ago men will not be deterred by the novelty of the thing from committing themselves to the guidance of aeronauts, if a machine can be made to fly quickly and safely against the wind.

This holds even in the science which is most closely allied to hygiene, viz., medicine. The exact line between the two is indeed at some points difficult to draw, and I certainly shall not attempt the task. But speaking generally, an alleged discovery in medicine gets a free hearing and a fair trial, and if it makes its claim good it will certainly be carried out in practice. The opposition to the use of anæsthetics—and some will think that I ought to specify still later outbreaks of fanaticism—was a survival of a noxious species of human error, happily so moribund that it will soon become impossible to catch a specimen for vivisection. But it is not so with hygiene. Here discovery is far in advance of application. The field of further research is indeed practically unlimited. But it is not too much to say that if what is already discovered could be realized in practice, though that day must be far distant, the face of society would be transformed. Why is this so? Why does practice not follow recognised truth in hygiene? I think mainly from two causes distinct in themselves, but often allied in doing their evil work. The first is indifference, bred partly of ignorance, partly of selfishness, partly of indolence. The second is the gigantic force of custom or fashion. Now I am fully conscious that any illustrations of these tendencies must seem individually insignificant, and insufficient to warrant such sweeping conclusions as I endeavour to draw. But I must entreat you to bear in mind that proof which is essentially cumulative in its nature must necessarily seem feeble in brief and incomplete detail; and I am sure that if any one will get into the mental habit of asking himself about all matters public or private, all arrangements however matter of course, all customs however firmly rooted, what are their hygienic bearings, that he will

more than confirm for himself any proof which I can offer here.

The first cause which militates against the practical adoption of known hygienic truth is that of *indifference*, and it is to the operation of this cause that these lectures will be mainly devoted.

It is not only the health reformer who has to encounter this. To the advocate of political reform, or, as I have shown, of speculative or scientific progress in general, it no longer presents a formidable front, but it is otherwise, I fear, with the preacher of righteousness. It is not that he fails to prove that his counsels are for the good and happiness of men as that there are other forces more potent over their wills than reason and conscience. But to-night I wish to be as little as possible a preacher. Other gentlemen who have addressed you have made earnest and vigorous assaults on particular positions of the enemy, whereas I seem to myself rather like the typical Irishman, who in a moment of evening excitement imagines himself at Donnybrook fair, and flourishes his shillelagh impartially among the heads of a peaceable crowd who are wishing for nothing so much as a quiet life. But I can imagine some one saying, "Surely this is an uncalled for display of energy. These quiet people whom you threaten to belabour will only be too glad to listen to anything you have to say on the savoury subject of drains, traps, and ventilating pipes, and to undergo any reasonable amount of expense and annoyance to themselves and their neighbours in carrying out your ideas—if you have got any, and they think them good ones. And as to water, why if you can make out a case against our present supply, and show that it possesses the noxious properties and contains the interesting forms of animal life, which were once supposed to characterise the water of St Mary's Loch, so far from your shillelagh performances being confined to yourself, we will promise you a general free fight to your heart's content." Well, ladies and gentlemen, I thankfully admit all this; and further, that the public conscience is beginning to awake to the fact that spreading infection, or (from mistaken ideas about personal liberty) allowing cases of infectious fever to remain where they cause danger to others, involves guilt of the same nature as

firing loaded guns haphazard in a populous neighbourhood; and, again, that the pollution of rivers and the frightful waste of fertilising materials caused by carrying town drains down to the sea, though for a time perhaps necessary evils, are fully admitted to be such, and that any feasible plan for putting an end to them will be gladly welcomed and in the end carried out.

I fear, however, that my imaginary objector would represent a wide-spread feeling of self-complacency; because in such matters as these, this generation *is* much more enlightened than our forefathers, and there is no doubt of the vast measurable effects of this enlightenment: the death rate has decreased, and the war against pestilence and fevers is being carried on with ever increasing success.

But if every house in the kingdom were guaranteed against the entrance of sewage gases and supplied with the purest water, the hardest battles of true health reform would still have to be fought. The age may plume itself on being liberal, and so long as progress goes on on recognised lines it *is* liberal; but when a new departure has to be taken, it will be the old story over again. Now please mark this distinction, for it is an important one. Sanitary science is advancing by leaps and bounds, so far as it deals with the surroundings of man, but the wet blanket of indifference is thrown over its most clearly proved truths when they relate to his institutions and habits.

Let me first take a subject which is on the borderland of this division—the subject of *ventilation*. It has certainly to do with man's surroundings, but it is intimately connected with his habits, because good ventilation is repugnant to those who do not lead wholesome lives. Pardon my saying it, but most of of you are probably too accustomed to rooms habitually overheated (hydropathics, *e.g.*, advertise a temperature of over 60°,* which is too great a contrast to the outside temperature in winter). You are also sensitive, because you are too indifferent about taking exercise, and also from the custom, far too deeply

* In America a much higher indoor temperature is kept up. And this fact has probably far more to do than climate has with that physical deterioration about which Americans are justly becoming alarmed.

engrained to be within the range of practical reform, of always having the head covered when out of doors, and uncovered when within doors. On this point I may mention that I looked in vain through the evidence about the blue coat schools given to a Royal Commission. It is a striking illustration of prevailing indifference on such matters, that not a question was asked as to the effect of bareheadedness. But from my own experience I can assert that boys who are usually bareheaded when out of doors can stand a greater amount of ventilation both in school-rooms and in sleeping-rooms than those who habitually wear head-coverings. From these and other causes, there is great practical indifference about the well-established principles of ventilation. Theatres are terrible offenders, churches are often nearly as bad. In how many of them, I wonder, are doors and windows freely flung open between morning and afternoon service? And how many clergymen or kirk sessions think much about the purity of the air in churches? I have heard of a church in the South of England where every aperture, including the keyholes, was stuffed up even during cleaning; and perhaps some of you noticed that the Crofter Commission did at least one tangible piece of good at Bunessan in Mull—they broke a church window, to enable them to breathe. As I remarked in a letter which the *Scotsman* kindly inserted, I wish they would do the like in every sacred reservoir of foul air in the country. And as to less sacred reservoirs, I hope that any representatives of a neighbouring seat of learning who are present will pardon my saying that I have heard strange tales about the state of the atmosphere in some of the University class-rooms, especially where the back benches rise towards the ceiling. I may have been wrongly informed. The known truths of ventilation may be so perfectly carried out and open windows so delighted in by both professors and students, that even the maximum of ·6 per 1000 of carbonic acid is never attained. If so, I apologise; I have been misinformed.

But as to schools, surely they at least ought both to teach and to practise plain and certain truths of science. Well, I have passed some buildings in Edinburgh, which I was told were

schools, and I could see no window open, even an inch at the top, nor any sign of overlapping window sashes produced by the simple and well-known expedient of a piece of board firmly fixed beneath the lower sash. And I saw announced in the gossip column of a school journal, as a piece of news, that a window had actually been seen open a few days ago!

And as member of a School Board, I have been nearly knocked down, not by the schoolmaster, but by the atmosphere, on entering a room after school hours, whereas all the doors and windows should be flung wide open after every hour. Now, I admit that the new Board schools are roomier and better ventilated than the schools which they superseded; but no patent ventilators can ever keep the air of crowded rooms as pure as it ought to be; and if we are to confine all the children of the nation for most of the daylight hours in winter, we should at least ensure that they breathe pure air. And here again we are complicated with other considerations. Why are so many clergymen and schoolmasters indifferent and unobservant about this? Why, because as divinity students or pupil teachers they have led too sedentary a life, and, in the latter case especially, they have half their vitality taken out of them by the excessive indoor work and confinement at an age when nature most resents such a violation of her laws. And, again, hygiene is not one of the subjects rewarded by the code. Physical morality is taught by no catechism, it holds a place in no articles or confession, or manuals of theology, though the laws of life and health are as much God's laws, as much binding, when known, upon conscience and upon practice, as if they had been thundered forth on Sinai. But I am anticipating.

The ventilation of the houses of the better class is perhaps tolerable, but what of those of the poor? Let me give you a remarkable instance of the indifference about which I am croaking. A year or two ago the fact was asserted on good evidence, and not denied, that consumption was greatly on the increase in the Highlands. They say that wise men write *for* newspapers, fools *to* them. I fear I am sometimes one of the fools. I wrote to the *Scotsman*. I suggested that the substitution of

slated houses and plastered roofs for loosely built thatched cottages had something to do with this. I happened to have summer quarters in a new slated house, fortunately unfinished. Had the attics been plastered, I don't see how any human being could have lived a night in them, and there are the bare rafters to this day. I live in the house every autumn. And there was only one skylight, and it wouldn't open, and some of the windows wouldn't open, others opened ever so little from the bottom. Well, I saw a good many of these slated houses. People said they were improvements, more civilised, and the like. Knowing as I did the ravages which consumption had been proved to cause among the Guards in London from bad ventilation, I didn't see how consumption could fail to arise under such conditions. I said so. Unfortunately I made some allusion in my letter—I forget how—to sea birds. To my consternation—I had dragged a red herring across the trail—a lively controversy arose about the birds; but when the vitality of a people was concerned,—and mark you the fact about the increase of consumption was never denied, whether true or not,—it was impossible to galvanise any public interest. Now I don't think that this was the only enfeebling cause at work in the Highlands, and discussion would have brought this out; but I fear that if the "Great Northern Diver" had been found breeding about a Sutherland Loch, more public interest would have been excited than it was possible to excite about the alleged deterioration of health in the Highlands. But there is light in the distance, as I hope to show you before I have done. Meanwhile I will pass on from the ventilation of buildings to the ventilation of towns by open spaces or lungs.

You must all know that the air of towns is not so pure as that of the country, and that the air of the crowded parts of large towns is injurious to those who constantly live in them. From this point of view the knocking down of what are called "rookeries," the opening of new streets, and the widening of old ones, has been of great benefit, and for much noble work of this nature Edinburgh can never forget the debt she owes to the memory of her great citizen, William Chambers. We must

also thankfully acknowledge the gifts of parks to towns by public-spirited men and women, like Miss Duthie and the late Sir David Baxter, though such gifts, as a whole, have been miserably disproportioned to the portentous growth and the crying needs of our great cities. But even with a sole view to ventilation, it is better to live in a well-ventilated house in the east of London than in an ill-ventilated house in the country; and the purity of the air in towns is a matter of secondary importance to the use made of open spaces and the general arrangements of their lives by dwellers in cities.

Those who sound most lustily the hallelujahs of modern progress seem to me wonderfully indifferent to the conditions of life in our towns. I am not speaking here of the seething mass of suffering and vice, the alleviation of which engages the earnest thoughts and efforts of increasing multitudes of philanthropists. This is not my subject, for though there is no doubt that all hygienic reform would co-operate in decreasing suffering and removing temptations to vice, such work must be mainly accomplished by other means.

But let us grant, for one instant, that these instrumentalities had done their work in a single city, that there did not remain within it a single wretch who hardly knew where to look for the next meal or the next night's shelter, a single child uncared for, a single criminal or unfortunate gaining his or her living from crime or vice, what would then be the destiny of its population, or rather of that part of it compelled by necessity, or induced by gain, constantly to reside and work within the buildings of that city under existing conditions; living, in fact, the lives which the great majority of our artizan, shopkeeping, mercantile, and professionl classes live at present? I will grant it perfect drainage, perfect water supply, and such ventilation as its habits will suffer to exist. But I will not grant that it shall be recruited from the population of country districts.

What will happen in a few generations? Very much the same thing which would happen to the Caspian Sea if the Volga no longer flowed into it. It would evaporate and gradually dry up. Well, this is a startling assertion. I am not going to trouble you

with many quotations, but please on this point allow me to quote from an article by Dr Cantlie, in Mr Morris' "Book of Health," pp. 394, 395.

"Examine the history of any of the leading men in almost any branch of industry in one of our large towns. Consider the parentage of such, and where they come from. How many of these men were born in the town in which they attained eminence? or perhaps it would be better to consider where their parents were born, and how they lived. The boy who becomes a lord mayor is always pictured as coming 'into' London from the country; and without drawing upon the imagination, let us consider the parentage of the lord mayors for the last thirty years. Of the number occupying the mayoralty during this time, twenty-five were either the children of parents who were importations to London, or themselves came into London at an early age. It is better to take these as examples, in preference to judges and politicians, &c., who, if born in towns, must almost of necessity have spent their youth at one of our universities or public schools, where, during the period of their youth, say up to seventeen or twenty, they have built up, under well-regulated mental and bodily exercise, a stronger frame, and started life with a better formed physique than the son of a townsman, who, trained in a city school enters an office at fourteen and pursues his calling forthwith. We find that the chances of such a lad attaining eminence are not great, and that of such stuff our greatest citizens are not made. Pursue the history of this town boy still further, and it will be found that the sedentary life inculcated, the close application, the hurried meals, the continual mental strain he undergoes whilst he is growing to manhood, are, in the face of them, but little calculated to engender the belief, even to a casual observer, that his children would be endowed with strong frames, or capable of much physical endurance. It is difficult—I will not say impossible—to find a third generation of pure Londoners, because the father or mother, a grandfather or grandmother is almost certain to prove to have been an importation into London, and the evidence forthwith breaks down. But it is doubtful if more than three generations are possible. We know

that in India the third generation of Europeans do not reach maturity, and there is but scant proof of pure Londoners continuing to four or five generations. The term pure Londoner is difficult to explain and limit. However, there are in London two millions of people whose parents have lived in London, whose sole knowledge of country air and scenes is gained, it may be, by an occasional bank holiday excursion. These are to be considered pure townsfolk; and it is in this class that the effects of town life on the progeny show in the extreme. In this class it will be found that the third and fourth generations are puny, and that the children of these late generations seldom reach maturity. Not only is it true physically that a family or nation declines, but with the stunted frame is a brain that begets morbid thoughts, that engenders a weak mind, that allows the individual to be driven to rash deeds—a mind that knows no control, the owner of which becomes the slave of his morbid inclinations."

Perhaps, however, the species would gradually adapt itself to its conditions, and might fulfil the brilliant anticipations of Mr Kay Robinson in his recent article in the *Nineteenth Century*:—

"The man of the future therefore," he says, "will not only be toothless, baldheaded, and incapable of extended locomotion with his imperfectly developed feet, but he will also be particularly averse to engaging in personal conflict,—a lover of peace at any price."

But suppose we do not take so extreme a view, suppose we admit that the extinction of the city race, or the more dreadful alternative of becoming "men of the future," will be averted by the improved and improving conditions of life so far as surroundings are concerned, by the banishment of drunkenness and other vices, and by the increase of holidays, the whole evidence goes to show that the sedentary population of towns living its present life and unrecruited from the country would degenerate into a feeble nerveless race.

Well, the Volga keeps up the Caspian. But let us suppose that by a geological subsidence the basin of the Caspian was being continuously extended and that the Volga dwindled, what would happen then? Why, before long, the sea would resolve

itself into reeking salt marshes, unless the evaporation could be stopped.* And are you not aware that every census shows an enormous increase in the area of towns, and a tendency to decrease in that of the country population which keeps up the vitality of towns? Nor is this all. Owing to various causes, such as increased facilities of artificial locomotion, increased substitution of machinery for manual labour, increased indoor and luxurious habits of life, disastrous changes in diet, and the fatuous ignorance of much of our educational zeal (of which more anon), the remaining sources of this vitality are in the way of being seriously impaired. Such being some of the problems of the health reformer, you will not, I think, deny that his difficulties are serious, and that the amount of indifference which he has to overcome is great. But before further discussing them, let me so far clear the ground. It has been said, and often repeated, "God made the country, man made the town." I deny the antithesis. God made both. He made man to be gregarious. He has endowed him with faculties which can attain their full activity and perfection only in large civilised societies, and he has also endowed him with a slow-working but indomitable force, which shall bend all the difficulties which from time to time bar his upward progress into opportunities for getting nearer to that perfection of his entire nature for which we cannot doubt that he is destined. There is another potential "man of the future," whom I will back against Mr Kay Robinson's, large in heart and brain, wholesome in tastes, keen in sensibilities, powerful in body, glorious in development, loyal to nature in habits, and if health reform can have full swing for a single generation, that man shall be grown in our towns.

Now what are the inherent deficiencies of town life as it is? Drainage, water, ventilation, may all be set more or less right on our present lines, and in matters of diet and clothing, truth may after a long and constant struggle overcome man's most powerful and most subtle tyrant, the force of fashion or custom.

* I am, of course, aware that another difficulty—viz., the Malthusian—must here suggest itself to many minds, but it is not a problem of the immediate future, nor is this the place to discuss it.

But in one point, and that the most essential of all, there is need not of reform, but of revolution, and that is the point of exercise in pure air. Now it is not my business to give you the physiological and other proofs of this assertion. For these I refer you to previous lectures and health manuals, and especially to Dr Cantlie's article already referred to. Neither have I space here to meet the many side issues which must occur to most of you, but I will confine myself to the one impregnable statement, that the immense majority of our indoor workers have neither the place nor the time to take such exercise as is needful for most, if they are to be healthy themselves, and for all if they are to be progenitors of a healthy race, and I need scarcely say that, as physical labour of the natural or productive kind is not usually available for towns-people, they must have recourse to artificial substitutes, which do the same physiological good.

Now, walking along streets or roads may do for older people, but certainly for younger men the primæval law of our nature, "in the sweat of thy brow thou shalt eat bread," is not to be satisfied by a mile measured walk, even if busy men had time to get enough exercise out of mere walking, which they have not.

But for proper exercise, outdoor or even indoor, where is the place, where is the time? Let me give you an instance of the difficulty of finding a place for exercise in the present state of public feeling. Many years ago I was associated with Drs Cathcart and Burn-Murdoch in looking out for a cricket field for the University. We enquired about almost every suitable piece of ground within easy reach. We were treated everywhere with courtesy, but in no instance did it seem to strike any proprietor or agent, "This is an urgent necessity, we will do our best to meet you." Of course we had no right to expect a present, but the spirit in which we were met, and I know of similar instances elsewhere, appeared to be this—"You are eagerly desiring a scarce article, and we will get out of you what we can." I am afraid there wasn't much to get out of us. Had it not been for the exertions of the Principal, made as these were when his hands were as full as they could hold of other business, we could not have scraped together enough to start any field. We were driven at last to

ook along the lines of railway, and I daresay, after all, the field at Corstorphine suits its purpose as well as any we could have got. Now I felt keenly on this matter because I knew something about the needs of Scottish Universities. I was at Glasgow for five sessions, and at Oxford for four years. Now some people are accused of Anglicising, of going to English Universities and encouraging others to go there for unworthy reasons. I will tell you frankly how the case stands from my own experience. I never got better or more stimulating teaching than at Glasgow University, and only in one instance did I receive as good public teaching at Oxford. And the standard of an Arts degree at Glasgow is fully as high as that at Oxford. I think, also, that Glasgow produces very few, if any, of the most objectionable types of Oxford man—the prigs and the spendthrifts (though the latter class especially are rarer than is often supposed). But Glasgow produces one type abundantly which Oxford hardly produces at all, and which no University ever should produce—the pale, narrow-chested, worked-out student. That this should be so is the natural result of the life at the two places. Work and exercise, I need hardly say, ought nearly to fill up a student's life. The immediate work is generally the better for the exercise, and certainly well-aerated blood is necessary to build up a brain strong in energy and will-power for the work of future life. Do you suppose that, I will not say the literary ability, but the colossal brain force of the Prime Minister could have been built up but for the out-door training of Eton and Oxford, and the active habits which he has carried on to an age when most men are used-up valetudinarians? Well, what exercise was available at Glasgow? Walks without an object, with now and then perhaps a day's skating.* A few enthusiasts took to rowing on the Clyde. One of them was capsized, and as if an immersion in that mixture of fluids wasn't punishment enough, the poor fellow was pilloried in a Glasgow paper, much in the same way as the shinty players have been "pulpited" by a reverend gentleman in the North, for amusing himself when he ought to have been at his studies.

* There was not then that magnificent gymnasium, for which Glasgow is indebted to the exertions of Prof. Ramsay.

But at Oxford nearly every one, and the hard-reading men most regularly of all, was out of doors every afternoon, many on the river (I remember a Balliol eight which had at least six first classes on board), many, according to the season, cricketing, hunting, riding, water jumping, playing rackets, fives, &c.; football then was played very little. I hope you will let me say that I feel more indebted to the Oxford boating system than to any other single element in my own education.

Now pray don't suppose that I am not alive to the fact that exercise may be overdone, and that it may be made an end instead of a means. Empty heads, if the bodies they belong to take to athletics, are like other empty heads. The people who read nothing but sporting papers, who make "pot-hunting" a business, would perhaps be otherwise strutting along Princes Street or lounging at refreshment bars. And I don't see that it would be any improvement.

But to return to our Scottish Universities. It is unfortunate that the largest of them are in great cities. But can't we make their difficulties opportunities? Can there not be a big effort to give Edinburgh University a worthy Gymnasium? As Professor Butcher said in an address to the students: "If the Greeks had had to carry on their gymnastics in a cellar, they would not have done for us what they have done in literature."

And should it not have numerous open fives courts? Not racket courts, observe. Fives are a better and much cheaper exercise than rackets. There is no game which takes up so little space and gives so much exercise to all the limbs and to both sides of the body in so little time and at so little cost. Where, you may say, is the money to come from? Money! the money would come fast enough if people cared as much about a fine breed of men as they do about a fine breed of horses! Where, I may ask, did the £13,000 come from to vulgarise a noble crag, in the neighbourhood of Stirling, with a purposeless excrescence? And, ladies and gentlemen, I fear my words will be wasted, but they must come out. People have got £12,000 quite easily for a testimonial to a most respected nobleman. I know how hard it was to collect a much smaller number of thousands to prevent

the builder from laying his clutches on seventeen acres, now secured as open ground, at Raeburn Place. I hear they are going to make a statue with this £12,000. Perhaps the Buccleuch Gymnasium or the Buccleuch Park wouldn't sound as well as the Buccleuch Statue; but which would do the greater good, which would be the greater honour to the Duke? Think which would have done the greater honour to our national hero, to spend the £13,000 as it was spent near Stirling, or in doing something to rear up men like him, to combat the evils of our time as he combated the invader? Perhaps, however, the time has scarcely come for enunciating the strange doctrine that intellectual and physical education should be co-ordinate from the primary schools to the Universities. Yet in this, as in other cases, it may turn out that the paradox of the present will be the axiom of the future. But we have to do with the present, and if the appliances for due exercise are given to the students, and if they are addressed by their Professors as they were by Professor Butcher, I know they will use these appliances. I know that their *esprit de corps* will increase as it has been increasing. And then the University will do what it ought to do. It will not only teach science, but it will act science; the light of physiology will not be hid under the bushel of the class-room, but will shine far and wide for the illumination of life; it will lead the van in a revolutionary movement, which, as I have tried to show you, is essential to the vitality of the people of our cities, and of their children after them.

And what a city it has to lead—inhabited by a people of a hardy stock, with ennobling traditions, and rarely equalled natural advantages, not the least of which is that there is a great deal of ground about it which never can be built upon. Even an Athenian would, I think, envy you some of these advantages; but I am sure he would be surprised at the way in which some of them are neglected. Let us take the Meadows. Many years ago I used often to pass between the East and West Meadows, when the former were crowded with cricketers in summer and football players in winter. But there were boards up on the West Meadows stating that no games were allowed at present.

So there was an occasional pedestrian there and a few nursemaids and children, who all looked very solemn, and afraid to run about in case they should be taken up for playing games. It seemed to me as though I were in a land where food was scarce, and on the one hand were fields bright with harvest, but on the other were wantonly barren lands of the richest soil. For the crop growing on the one side and forbidden to grow on the other, was that on which the old Roman legend tells us that the greatness of a nation is based, its manhood. For as in the cornfield one can see as it were the rising sap, and the swelling ear, and the bursting grain, and bread for the hungry people, so here, no one who thought upon it could help seeing the pure air of heaven rushing at fourfold pace through the lungs of the indoor toiler, and the aërated blood coursing through his veins, clearing away noxious deposits, and building up the bone, and the muscles, and the nerves, and the healthy brain, and the strong will, and the buoyant energies which are the life and the power of nations. And one would thank God that there was widely spread among us the instinctive craving for such activity as I saw then. For no knowledge, and no wealth, and no "silver streak" can save the island of crowded cities when her manhood shall be gone. Well, years have passed by, and what has become of the Meadows? In summer there is a rather stunted crop growing (after a vigorous attempt to root it up) on the West Meadows, for if I am rightly informed, no roller is by the laws of our city agriculture allowed to be put upon that enclosure. On the East Meadows there is no crop at all, and in winter there is a small crowded crop at Stockbridge, a place too remote to be of any practical use to the old town. But the Meadows, East and West, forcibly realize the text, "A fruitful land maketh He barren for the wickedness of those that dwell therein." Yes, my friends, it is not the fault of the Town Council, it is your own. Do you make this a vital question at municipal elections? Has it ever turned the scale for any candidate? and do you expect all the Council to be like our chairman unless the question is raised at elections. Remember the argument is all on one side. Our foe is a Parthian foe. It wont come up to the scratch. It

wont discuss. It now and then sends a stray shot which doesn't hit. For instance, they say that any games, *i.e.*, anything but a solemn walk on the Meadows, are dangerous. Now I hope I have showed you that there is a danger in inactivity which compared with that of any game is as consumption to a cut finger. But the argument of danger irresistibly reminds me of what happened when some Englishmen started cricket at Riga in Russia. Being told it was a dangerous game, the authorities sent a policeman to see for himself and report. Anxious to be accurate in his statements, he persisted in standing at the place of a near point. Quite unintentionally he fielded a ball with his head, and his skull not being so thick as the skulls of the people who sent him there, he was hurt. And so the game was stopped by the authorities. Now this is a fact.

There is another case, however, which for absurdity and unreasonableness, throws the case of the Meadows in shade. Having games played on the Meadows would certainly prevent a number of people from using short cuts, and add a few hundred yards to their daily walk. Considering that probably not one in ten of these people takes nearly enough exercise, there would be no great evil in this; but we can scarcely expect the sedentary business men who predominate in the Council to look at football as a means of health rather than as a rough and dangerous amusement for which they have no personal predilections. But would that the Council were supreme all round the city! Scotchmen may make mistakes, but they mean, according to their lights, to do what is for the good of Scotchmen. If you want an example of obstinate recklessness and ignorance in dealing with Scottish interests, you have to find some instance in which their interests are dealt with by an English board or department. Unfortunately the Queen's Park is under the Board of Works. A petition was sent to the Board with the unanimous assent of the Town Council, and signed by 4500 citizens of Edinburgh, to ask leave for the football players to use a piece of the Queen's Park, near Holyrood, when not needed for drilling purposes. The petition was sent in May. In August the reply was received, "That having carefully considered the matter, the Board regret that they are unable to

set aside a portion of Holyrood Park as a recreation ground for football and other games." No reason was assigned. But on August 10th, in reply to a question by Lord Rosebery in the House of Lords, Lord Thurlow said, "That granting the request of the Edinburgh petitioners for said purpose would be inconsistent with the general enjoyment of the ground by the public." Now some people have been anxious to ascertain the nature and extent of this enjoyment, and so a watcher has been on the ground for the last four Saturdays from 2 P.M. till dusk. As you know, they have been fairly fine days. It has been found that the ground is used for two purposes. There is a path over it which saves anyone going towards St Margaret's Loch about, I believe, 100 yards. The total number of persons lessening their daily exercise by this amount on the four Saturdays has been 107, more than half of whom have been children going to sail boats and play about St Margaret's Loch. This has been the first purpose observed ; the second is rather curious. On one Saturday four persons for some time derived a peculiar, and no doubt intense, enjoyment from the ground. They were boys, and their enjoyment consisted in taking successive draws at one cutty pipe.

I passed the ground to-day. It is a muddy, melancholy flat. What form of enjoyment any of the public could derive from it, except taking a short cut, and smoking cutty pipes, &c., when the terraces and slopes of Arthur Seat are close at hand, it is impossible to conceive.

Again, why are there no large public swimming baths in the old town of Edinburgh ? Why had a private company to try three times before they got the money, about half a "statue," to start the Drumsheugh Baths ? Why are not several "statues" subscribed to keep ground open near the city ? For, depend upon it, an enlightened generation will at a vast sacrifice pull down where we are building up. Why is there not one open fives-court in Edinburgh ? and only one or two gymnasia, and one of these in a cellar ? Why, on the few occasions in which skating is available,—an exercise which makes a crop of vigour to grow like Jonah's gourd,—is the forming ice on the two nearest lochs allowed to be smashed by thoughtless boys, all for

want of a watcher or two? Why can't the public or rich private persons pay the canal company a fair compensation to stop their ice boat? Why are no artificial slides made in proper places for boys and children, as might easily be done?

Another matter has been brought before my notice since this lecture has been in type.

At a meeting of the Governors of Heriot's Hospital the other day, two of our city clergy advocated the formation of a bowling green in the Hospital grounds for the working classes. Now bowls is to the elderly working man what golf is to the lawyer. It would mean health and life to many.

Three objections were raised by different speakers,—1st, Where was the money (about the sixtieth part of a "statue") to be found? 2nd, That the thing was "so absurd." 3rd, That they might require to build on the Hospital grounds.

I think I have merely to state these objections to prove my contention that they show an astounding indifference to the elementary facts of physiology, and to the needs of our great cities.

And why don't you make more use of the Pentlands? Road walking is a poor sort of exercise, but hill walking both for the climbing and for the strong air is a very good one. Are some paths shut up? Why were they shut up? Why, because you didn't use the Pentlands. I know you didn't, for I have been over them again and again in every direction, and scarcely ever met a soul; and so long as there is no law of trespass (provided no damage is done) I shall go over any open ground I please; and if such a law were in operation, I should be tempted to become a Radical on the Land Question. For there is not another country in the world which shuts up its mountain land as some people have most audaciously and most unpatriotically attempted to shut up vast tracts of the Highlands, chiefly for the lounging, sneaking, murderous mockery of sport called deer-driving,* and to the injury of healthy sport, and of other things which do the same sort of good as sport, the pursuits of the naturalist, the artist, and the mountain climber.

* A very different thing from the noble sport of deer-stalking.

Now why don't you use the Pentlands? I think that some public spirited proprietors must have held a meeting, and resolved to call you to a sense of your neglected opportunities, and to put your backs up (as the phrase is) by shutting up old paths. There couldn't be any other reason. They could scarcely hope to keep them shut, could they? And, thanks to some of your fellow citizens, I trust they cannot keep them shut, and they certainly shall not shut up the hill sides, and I hope the result of it all will be that more of you will see the view from the top of Carnethy than ever saw it before.

But where is the time to come from for all this exercise? This is a very difficult question to answer, and I have taken up so much of your time already that I shan't enter upon it now. But pray don't think there is no way out of this difficulty, or out of most difficulties. The Committee have kindly allowed me to cut this lecture into two. Next Saturday I shall try to answer this question, and to point out other instances of indifference in connection with food, and with a subject which has lately caused great and justifiable alarm, viz., the demands of modern education, in defiance of physiology and of common sense, on the immature brain. I purpose next to discuss the difficulties caused by the gigantic force of custom or fashion; and I shall conclude by briefly indicating (for the subject would require a lecture to itself) the means by which the laws of God, made known to us by science as affecting man's health and well-being, may be gradually recognised as laws which we are intended to obey, may become an essential part of the ground-work of education, may be bound up with the fundamental principles of morality and religion, and may at last, by that riper civilization which we may see afar off, though we may not enter into it ourselves, be realized in practice.

THE DIFFICULTIES OF HEALTH REFORMERS.

PART II.

By H. H. ALMOND, M.A., Oxon.,
Headmaster of Loretto School.

I left off the last lecture in the presence of a serious difficulty—Where are indoor workers to find the time for outdoor exercise? Before attempting to answer this question let me briefly sum up the grounds for believing the subject to be one of grave importance.

I showed last Saturday that there is reason to believe as a matter of fact, that such a thing as a fourth generation of pure Londoners scarcely exists. But even if this statement is questioned, there can, I think, be no doubt that, under modern circumstances, indoor city workers, leading the lives which most of them lead, do as a race, unless recruited from a healthier stock, tend to degenerate, if not to disappear. And as a matter of theory there can be no doubt that physical labour, for one sex at least, is a physiological necessity for a thoroughly robust individual, and that the degeneration of a sedentary race might be predicted, even if it were not established as a fact.

I am the more anxious to make this clear, because it is a thing which is very little thought of, and which is the cause of disastrous practical mistakes.

I have heard successful lawyers and men of business refer to their own careers in an aggrieved and desponding spirit, because there was no sign of its being emulated by their sons. They tell how they entered an office at fourteen or fifteen years of age; how they worked all day, and often far into the night; how, except on rare holidays, they got no outdoor exercise (which they would probably call "play") to speak of, and there they were, and why should not their boys do as their fathers had done. And

I have sometimes been told the axiomatic truth, but in a tone which quite politely indicated that I might be somewhat heretical on that subject, that there was nothing like hard work. My answer has been what I have often found regarded as a new and startling paradox. Their sons cannot do it because their fathers did it. They have used up in their own persons an exceptional amount of vitality, which has enabled them to struggle successfully against unfavourable and unnatural conditions of life. Surely this explains a fact which has puzzled writers on heredity, viz., that a successful family tends to decay after a generation or two. And it also explains the exception to this rule, viz., the permanence of great qualities in many noble, and notoriously in royal families. It is not the work which kills the vitality, it is that the brain as well as the body is starved for want of the aërated blood supplied by physical labour in pure air.* The outdoor sports which some dyspeptic theorists have decried as "barbarous" have supplied this necessity to the families which have maintained their vigour, and in spite of the strong force of heredity acting the other way, the absence of some form of physical labour has caused what I may call the sedentary families to degenerate. Other causes, such as the coddling and improper feeding of the children of rich townspeople, doubtless co-operate, but the main cause is undoubtedly the one I have stated.

How then is the time to be found for such exercise? Of one thing we may be sure, that if the public becomes imbued with the belief that such labour is above all luxuries, and among the

* It would be hard to find a better illustration of the ignorance prevalent among men of "culture" about the things most necessary to be known, than the following remarks which occur in the *Spectator* for January 19th:—"Sir Charles Dilke presided on Tuesday at the annual dinner of the Tricycle Club, and predicted a great future for cycling, in which he is probably right. But we suspect he was quite wrong in saying that 'physical exertion was probably necessary to fit men for mental work, and to men engaged in such work was an important and necessary relief.' Is that any truer than to say that mental exertion is probably necessary to fit men for physical work, and to men engaged in such work is an important and necessary relief? We believe that the one assertion is quite as true—or quite as false—as the other."

It might as well argue in this way: "Steam is necessary for the engine." Is that any truer than to say "that the engine is necessary for the steam"?

very chief of necessities, the time as well as the place will somehow be found.

But for the present let us go into some details about the path of possible reform. At present for several months of the year almost the entire hours of day-light are spent indoors. I am sorry to hear that during recent years students have had a fresh obstacle put in their way. In my own time at Glasgow our afternoons were always free, and now I hear that there are classes at Edinburgh University which destroy the possibility of afternoon exercise, viz., between three and five. The time bill, I shall be told, cannot be otherwise arranged to suit modern requirements. Then so much the worse for the modern requirements. This piling on of subjects, from other points of view, for both medical and art degrees, stinks in the nostrils of the health reformer, as I shall show later on. But if they clash—health and the extra subjects—which, in the interest of the student, in the interests of his future patients, parishioners, scholars, or family, ought to go overboard—some additional and possibly ornamental knowledge, or the vigour of his brain and body for the work of life? The case of clerks and shopmen is worse. They are, I fear, as a class, a holocaust on the altar of material success. Can nothing be done for them?

Let us begin by putting in the thin end of the wedge. If every indoor worker used dumb-bells or Indian clubs for ten minutes, or took a brisk walk before business hours, the advantage would be great. Let him be thankful if his office is in Leith, and let him vow never to get upon a tram-car. After business hours, it is dark; still I have heard of some ardent spirits getting up in flannels and taking runs on the roads to the wonder of the lieges. They stare. Why do they stare? Let them stare. And if the gymnasia which exist are used, and if rich employers of labour see their duty as they ought to see it, more will spring up. Again, swimming is a glorious exercise. We hear a good deal about its usefulness in saving the lives of others. But few people seem to think that daily access to swimming baths would often keep up the vitality of the swimmers. I hope that the Drumsheugh Baths, in which I hold shares, may soon be run hard by other companies. Oh, if people would only realise the good of such things! One

"statue" would pay for two large public swimming baths. Couldn't we have a Buccleuch Swimming Bath, or a Chambers' Swimming Bath, and a bazaar for it?

Again, is it out of the question for places of business to close much earlier on Saturdays? so that townsfolk may get a good long stretch—let us say over the Pentlands, if no more exciting exercise is available. Some will say, "Oh, in this uncertain climate!" which would prove that they are not in earnest about exercise. It may need a little resolution at first, but seriously I believe the worse the weather the greater the enjoyment—not just at first, but when you are fairly mastering the elements—and certainly the after-glow and the recollection are more delicious. As to cold, provided any one never drives in trains or cab or car when wet or cold, and never sits down in wet things, there is no danger. And to touch for one moment on a delicate subject, the Sabbath was made for man. It was made to supply for each man the rest which he most needs. The strictest puritanical Sunday is indeed better than the Continental Sunday of work, or of what is grimly called gaiety; but to encourage the indoor worker to aërate his blood and refresh his brain by deep draughts of pure air is surely the same in principle as to cause the wearied peasant to rest from the labours of his hands.

Such instalments of progress as these ought to be brought about without much disturbance of existing social arrangements, but they are far from satisfying the demands of hygienic economy. That an immense number of men, especially of young men, and still more of boys, should be engaged in sedentary employments, often in impure air during what are practically the whole hours of daylight for many months in the year, is monstrous. It is a sin against light and knowledge, and will be looked upon by any age which has mastered the principles of physical morality as we look upon the drinking and duelling habits of our forefathers. And it is an instance, not merely of stupidly conservative indifference, but of that more hopeless apathy which goes from bad to worse.

Business hours occupy more daylight than they did some years ago, yielding like everything else to the late hours and morning indolence of so-called society. The courts used to sit at nine, now they sit at ten; offices used to close at three or four, and

open again in the evening for an hour or two. You all know what the hours are now. They are far too late, and, except at some very busy times of the year, unnecessarily long. Will any business man tell me that if there is a will in this matter there is no way; that half-a-dozen men, commissioned by the general assent of the community, could not so rearrange matters by beginning earlier, by shortening some cumbrous conventional forms, and by other arrangements for preventing waste of time, and if necessary, by opening again at night for the winter months, that one of the first necessities of health should be secured to all who will make use of it, though until the truths of physical morality are made an integral part of education, only a minority may make use of it? But suppose this is impossible, suppose the hours to remain as they are, is no alleviation possible? I asked a friend once if fives courts could not be built for the clerks on spare pieces of ground behind offices. Of course I heard that this would be too eccentric, scarcely respectable, &c. He was quite right, I suppose; but surely, ladies and gentlemen, this shows a very wrong state of feeling. Either the accepted doctrine of the aëration of the blood by physical labour is wrong, or the state of feeling is wrong, one or the other.

I am satisfied, if leading lawyers and merchants and bankers felt the truth, as well as knew the truth, that a crop of gymnasia, fives courts, and lawn-tennis courts would spring up, and that many dreary hours in which clerks and even principals are gossiping or reading novels, would be spent in gaining benefits which are as demonstrable as the truths of Euclid.

Of course I know that all this is unpractical at present. Why then have I taken up your time in sketching such a Quixotic scheme? Why, because the more unpractical it is the more it proves my contention: that health reform is obstructed by indifference, and will be so till education and life are saturated with its teachings.

But what of my next subject—food? Does this indifference extend to it? or is there not rather a tendency to a morbid fanciful particularity about what we eat and drink? And are not violations of health laws in this respect due rather to individual self-indulgence than general apathy?

This is increasingly true, with many qualifications, of the private life of a large part of the wealthier and middle classes; but sins of indifference are neither few nor small. It is surely not necessary to dilate on the importance of an abundant milk supply. Milk is the only food which contains all the necessary elements of diet, and healthy children cannot be reared without plenty of it.

Now, not only in towns, but in many country districts the children of the poorer classes are being starved and stunted from want of milk. You can't grow men without growing children, and you can't grow healthy children without plenty of milk. I wonder if this truth was mentioned in the free trade debates of 1846. I have read most of these debates and don't remember that it was. It would have constituted the only sound argument of the Protectionists against free trade in cattle, but political economy was then in full swing, and I doubt if hygienic economy could have got a hearing. For the latter insists on there being cows enough in the country to supply abundant milk for every individual in it. I have not known where to look for statistics, but I fancy that the milch cows in the country have *not* increased in proportion to the population, or even absolutely within the last thirty years.

And then the nation became victimised by a craze, ruinous from many points of view, for the enclosure of commons. Fortunately, that is now seen to be sheer madness, and the successful fight for the preservation of Epping Forest is a sign of a more wholesome state of feeling.

But not only in very many instances have the healthy sports of villagers been put an end to, but the villagers have lost the feeding ground for their cows, and now in many parts of the country the poor people can scarcely get milk at all. The farmer finds it pays better to send it to London and other big towns. Now it is very well to sneer at grandmotherly legislation, but there will be more grandmothers than grandchildren unless there is milk to be had. If giving the labourers votes will enable each of them, I scarcely care by what means, to have a cow's grass secured to him by law—well, I hope they will get the votes, though for sentimental political reforms I don't care a jot. We can't afford to lose any of the affluents of the Volga, which keeps up our national Caspian.

Now we have been growing bigger and stronger men in Scotland than in England. I'm not bragging, for I'm an Englishman. And I can't stop to give you proofs, but I will just say in passing that the way in which the little country holds her own with the big one in Rugby, and still more so in Association football, is a fact which strongly illustrates my assertion. And the bigger men have been throughout the world the most successful men, out of all proportion to numbers, and the bigger men, other things being about equal, are the product of the better food, oatmeal and milk.

There may be other causes, but depend upon it this is the chief cause. Now is it true, that partly from a shorter supply of milk in proportion to population, partly from ignorance about food, and also, I fear, a certain snobbishness about food, that tea and white bread, *i.e.*, bread robbed of some of its best qualities and made to look as if it were more robbed than it is, have been largely taking the place of oatmeal and milk? I don't say that this is the case among grown-up people of the richer classes, and with them it matters less, because the ingredients of perfect diet are for them supplied in other ways. But it does matter greatly for the poorer classes, and it is a question of strength or of feebleness for the children of all classes. I have often been perfectly aghast on finding that people who could afford good milk have been trying to bring children up on white bread and tea and slops. And then if the poor things are delicate, they think that the cure is warm rooms, frequent feeding on dainties, confinement to the house when wet or cold, plenty of wraps and slow motion out of doors on fine days!

If the principles of diet and life were taught in some of the schools for both sexes, instead of the mountains of South America, or the lives of the poets, or that painful exercise called paraphrasing, there would no longer be the excuse of ignorance for such disastrous blunders as these and many others of a similar nature.

I mentioned football players. Let us say a word to them. I can't be accused of want of sympathy for games. There isn't time to mince words, and I hope they will excuse plain ones. The game attracts spectators. Spectators pay gate-money. Gate-money pays for football tours. Good and well; and it pays for something which is not good and well, expensive football dinners.

Now I know that a good many football players don't like this, and they haven't the pluck to decline to go. They are more afraid of giving offence, than of doing a thing bad for themselves, worse as an example. They know that these dinners put men out of training. They make a farce of the final matches of the tour, if played by the same men. I saw an instance of this mentioned in an English paper the other day. But they do something worse than spoil football. After severe exercise, permanent injury is more easily done to the digestive powers than at any other time. In all athletics, going out of training has done far more harm than overtraining. And these football dinners will do far more damage than all the football accidents about which all the old women scream, and damage of a more lasting kind too. Now, be deaf, if you are wise, to the kind invitation of the outsiders who promote these entertainments. Tell them that you will be very glad to see them in your scrimmages, but you won't go to their dinners. Never mind if some of the papers abuse you, as the London press once abused the Oxford crew for refusing to go to that dreadful feast after the boat-race. If you can't stand a bit of abuse, you will never do any good. And then, silly abuse for doing what is right is so infinitely amusing that it lightens the real difficulties of health-reformers.

A good deal has happened since I wrote my remarks on this subject. We have had a visit from the Vice-President of the Committee of the Education Council. And I think that, however much we may all differ on other matters, we must all agree that Mr Mundella has displayed great qualities, and deservedly won golden opinions on all sides. He has not degraded education by making it a stalking horse of any political or ecclesiastical sect, and he has displayed an industry, a mastery of detail, an open-mindedness, and an enthusiasm which are the very antipodes of the red tape officialism which we have often had occasion to deplore. It is one of the great defects of our present system of party government that any change of Ministry might possibly instal a successor in the Education Department who had the very rudiments of his subject to learn.

That he views education more on the purely intellectual than on the physiological side, is the necessary result of that tone of public opinion, which it is the object of these lectures to combat

It must indeed have gladdened the heart of every health-reformer to read his remarks on the over-work of pupil teachers to which I referred in my last lecture, and his criticism on the manner in which the present working of payment by results puts a premium upon over-pressure.

But there is one remark of his which I wish to quote, as I think it is the source of a common and dangerous fallacy. He says, "Now I don't mind the boys working a bit. I have been a lad myself and worked very hard, and a little hard work does not harm a boy." Quite true, it not only does not harm a boy, but it does him a great deal of good. Nothing great or good is done without hard work. What harms a boy is the presence of hard mental work coupled with the absence of hard physical work. Without some form of physical labour, as I tried to show in my last lecture, it is impossible for an individual to be thoroughly robust, and it is certain that a people will degenerate.

What I complain of is, that our town schools in general do not supply this physical work, and that people's eyes (even Mr Mundella's eyes) do not seem to be open on this subject. Do not think that by physical work I mean merely games; though games in their place are right and necessary. But every town school ought also to have a gymnasium. Gymnastics should be a compulsory school class, and every boy ought to learn, if not a manual trade, at least how to use carpenters' tools; and if he also learns to use a pickaxe and a spade so much the better. Such learning would not only save many a colonist from ruin or starvation, but it would keep up the health and vigour of many brain workers, as the use of the axe has kept up Mr Gladstone's.

I fear that in our zeal for intellectual education we have been losing sight of a great truth, eloquently expressed by Archdeacon Farrar: "Physical work is a pure and noble thing, it is the salt of life, it is the girdle of manliness, it saves the body from effeminate languor and the soul from polluting thoughts. And therefore Christ laboured, working with his own hands, and fashioned ploughs and yokes for those who needed them."

I know how hard it is to manage this matter of physical labour, natural or artificial, in towns. It can indeed be managed by schools for the wealthier classes, more easily than by grammar

and board schools. But nothing can show more clearly the extent to which this momentous matter is ignored, than the schemes which are afloat for connecting primary and secondary education. An influential speaker mentioned last Wednesday with approbation, the remark of a friend about a clever boy at a country school, "What a pity it is that that boy cannot get a bursary, and go away to some town." Now, great ability will force its way anywhere; but depend upon it, if you bring a number of country boys of moderately good ability into towns, if you give them hard mental work and little if any physical work, you will simply succeed in turning a number of feeble youths, without capital, and rendered incapable of earning a living by manual labour, into the already over-crowded occupations open to men of education; and one chief result of this wrongly-directed zeal will be a number of consumptive copying clerks.

But why should not our vast educational endowments be partly used in erecting great and cheap schools in the country, like the Devon county and many others in England, where an all-round healthy education could be given, and not one in book-knowledge alone? And other schools again, on a somewhat similar plan to Cirencester and Dowton Agricultural Colleges, where a technical education should be superadded to the intellectual, and some of these clever boys turned into what is so much wanted in our colonies, robust emigrants with scientific knowledge, and yet with a mental training which shall prevent them from sinking into boors?

But it must be evident to all who have read the accounts of recent meetings, that the hygienic aspects of education are being ignored by our leading men; and if they continue to be so ignored the proposed developments of our educational system will do a great deal more harm than they will do good.

The truth is, that the public have been looking at education too exclusively from one point of view. They have not studied Dr Clouston's subject for next Saturday—"The child, body and brain." I hope you will all come and hear what he has then to say, for he knows more about the subject than you or I do, or than any of the statesmen and notabilities do who have lately been making educational speeches.

I will not trespass much upon the ground which I think he

will take; but there is one important feature in the present education of the child in Scotland which I have tried to realise, in imagination, as applicable to myself.

Suppose a large portion of my income depended on pupils passing certain examinations at particular ages, and suppose I said to my colleagues, "Now, gentlemen, as my income depends, so yours must, on the number of boys you pass." Would I not be putting a premium on their regarding their boys as simply machines for getting passes? Is human nature so universally disinterested that I could expect them all to study their charges from the health point of view, to recommend that one should not work by gas-light because his eyes were weak (the German experience on this point is worth studying), or that another should not be pressed because he was growing more than the normal rate, and that the calls on vitality in other directions demanded that for a time no serious call should be made by the brain? And this danger seems to me intensified in case of the Board schoolmaster. A leading man in the profession writes to me: "These Boards value their teachers by their percentage of passes, and this forms another stimulus to the teachers, and leads to inconsiderate teachers keeping children in past the hours in their time-table, even though they be weak both physically and mentally." Now, if *I* were to regard boys simply as representing so many passes or marks, they have parents who are more keenly alive to signs of danger than the parents of very poor children are. And if the poorer parents do see that their children are stunted, or suffering in eyesight, or from headache, or listless from too rapid growth, or if they agree with an eminent physiologist, quoted by Mr Herbert Spencer, that many children should learn no lessons till they are eight years old; why, the officer delivers them to the school board, the school board to the sheriff, and they are cast into prison.

I know well enough the evils of leaving such discretion in parents' hands, but why, I ask, is there not a physical inspection of schools? to test the ventilation, to take registers of growth, chest girth, and lung capacity, to prescribe which children should be full and which half timers (on which subject—referred to, I am glad to say, by Mr Mundella—*vide* Mr Edwin Chadwick's too much neglected blue-book), and which should be relieved for a

time from brain work altogether. Then ought there not to be daily drill for all, if possible in the open air, and ought not inspectors to award grants, not only by the regular school work, but by proficiency in such drill, by the discipline and cheerfulness of the children, and by those numerous indefinable signs of health and well-being which cannot be mistaken by a practised observer?

N.B.—On this whole subject I wish to refer to an extract from the *Medical Times*, printed in the appendix to this lecture.

I cannot give you a better proof of the indifference prevalent about such matters than the words of an eminent living statesman. I don't name him, because I don't want to drag in political associations. "Everything that can be said on the subject of education has been said hundreds of times over." So it has, if you regard education as the battlefield of political and ecclesiastical sects. So it has, if you look upon the immature brain as a sort of disembodied and infinitely elastic wind-bag, which is the point of view taken in weary piles of blue books, in precise, cold-blooded codes, or in the polished platitudes of numerous honourable, right honourable, and noble amateur educationists, most of whom know as much about the body and brain of a child as I know about the working of the Home Office or the India House. But so it has *not*, if you regard education as the scientific and harmonious development of the entire nature. Even from a purely intellectual point, if we look upon the brain as an organ and not as a wind-bag, if we consider that the main object of intellectual education is not so much to inform (except on one or two subjects, the most important of which, as I shall show you, is almost utterly neglected) as to train, that its success is to be measured, not by the knowledge which it temporarily imports, as by the powers of acquiring and using knowledge, which it permanently strengthens, we are in the midst of an educational chaos. This is fortunately not my subject. I have not to discuss here the conflicting and still unsettled claims of what I may briefly denominate the old and the new learning. What I have to do with is the indifference which has been shown concerning the health, both of mind and body, of the victims of this conflict.

I need scarcely say that though under any circumstances the addition of new subjects without the suppression of old ones

would have required careful watching from the health point of view, yet the dangers in this direction appear most strongly in connection with the examination system, which now dominates education, and which has attained its present portentous dimensions within the last thirty years. Some method of testing merit was certainly rendered necessary by the abuses of patronage, but that health considerations have been ignored by the framers and promoters of the examination system is, I think, undeniable, and the outcome of the system as actually worked is admitted by every true schoolmaster whose opinion I know to be fraught with much evil. But I am aware that the opinion of schoolmasters is not worth having—on educational matters. Education commissions do not include a single expert, though I would like to see the flutter there would be in the assemblies and the Parliament house, or among medical men, if other professions were ignored in this way. As to the way in which the Board schoolmasters have been ignored, I had written something else very strong and very true. But something has happened since I wrote. Mr Mundella's noble speech at Glasgow is the first instance I have met with of a sympathetic recognition being accorded to them by any English official.

So I will give you first, the opinion of the greatest living philosopher, Mr Herbert Spencer. In his Essays on Education, which are less known than they should be, and which contain more valuable matter than could be distilled from all the speeches on the subject which I have seen in newspapers, he says, "And if, as all who investigate the matter must admit, physical degeneracy is a consequence of this excessive study, how grave is the condemnation to be passed on this cramming system above exemplified. It is a terrible mistake from whatever point of view regarded. It is a mistake in so far as the mere acquirement of knowledge is concerned.

"For the mind, like the body, cannot assimilate beyond a certain rate; and if you ply it with facts faster than it can assimilate them, they are soon rejected again; instead of being built into the intellectual fabric, they fall out of recollection after the passing of the examination for which they were got up. It is a mistake, too, because it tends to make study distasteful. Either through the painful associations produced by ceaseless mental

toil, or through the abnormal state of brain it leaves behind, it often generates an aversion to books; and instead of that subsequent self-culture induced by rational education, there comes continued retrogression. It is a mistake, also, inasmuch as it assumes that the acquisition of knowledge is everything; and forgets that a much more important thing is the organization of knowledge, for which time and spontaneous thinking are requisite. As Humboldt remarks, respecting the progress of intelligence in general, that 'the interpretation of nature is obscured when the description languishes under too great an accumulation of insulated facts.' So it may be remarked respecting the progress of individual intelligence, that the mind is overburdened and hampered by an excess of ill-digested information. It is not the knowledge stored up of intellectual fat which is of value, but that which is turned into intellectual muscle. The mistake goes still deeper, however. Even were the system good as producing intellectual efficiency, which it is not, it would still be bad, because, as we have shown, it is fatal to that vigour of physique needful to make intellectual training available in the struggle of life. Those who, in eagerness to cultivate their pupils' minds, are reckless of their bodies, do not remember that success in the world depends more on energy than on information; and that a policy which in cramming with information undermines energy is self-defeating. The strong will and untiring activity due to abundant animal vigour go far to compensate even great defects of education; and when joined with that quite adequate education which may be obtained without sacrificing health, they ensure an easy victory over competitors enfeebled by excessive study; prodigies of learning though they may be. A comparatively small and ill-made engine, worked at high pressure, will do more than a large and well-finished one worked at low pressure. What folly is it, then, while finishing the engine, so to damage the boiler that it will not generate steam! Once more, the system is a mistake, as involving a false estimate of welfare in life. Even supposing it were a means to worldly success, instead of a means to a worldly failure, yet in the entailed ill-health it would inflict a more than the equivalent curse. What boots it to have attained wealth, if the wealth is accompanied by ceaseless ailments? What is the worth of distinction, if it has brought

hypochrondria with it? Surely no one needs telling that a good digestion, a bounding pulse, and high spirits are elements of happiness which no external advantages can outbalance. Chronic disorder casts a gloom over the brightest prospects, while the vivacity of strong health gilds even misfortune. We contend, then, that this over-education is vicious in every way—vicious as giving knowledge that will soon be forgotten; vicious, as producing a disgust for knowledge; vicious, as neglecting the organization of knowledge, which is more important than its acquisition; vicious, as weakening or destroying that energy, without which a trained intellect is useless; vicious, as entailing that ill-health for which even success would not compensate, and which makes failure doubly bitter."

Next I will give you the opinion of an educator who was allowed a hearing, and was honoured, I think, by a leader in the *Times*, chiefly, I fancy, because he was for a short time in Parliament, and thereby became a member of that circle of peers, M.P.'s, and celebrities whose opinions on all subjects are worth recording. The writer is Mr Wren, the prince of so-called "crammers." Some people are scarcely fair to crammers. Their business is to get boys through certain examinations. Where "cramming" is unluckily necessary, they cram; but they also *teach*, at one particular stage, better than most schoolmasters do, because this stage is their speciality. That boys have to be sent to London to be so taught, with scarcely an element of healthy life open to them, is the fault of the system, not of the crammers. The purport of the letter (the whole of which will be found in an appendix) is a protest against competition at the growing age. It concludes—"You cannot make babies do boys' work; and you cannot make boys with immature brains do young men's work without injuring these brains; and mark, the brains always give way before the physical health suffers. If you put too many irons into the fire of a boy's mind, and keep on blowing at that fire to see whether you can keep all these irons hot, you will very soon burn that fire right away to dust and ashes."

I have not space to go into details, or I would tell you how the public school scholarships can now scarcely be obtained by any boy who has not had an arduous and expensive training, and how, consequently, the gifts of past ages to the poor have been

perverted into an unhealthy stimulus for the rich,—how for college scholarships, similarly perverted, and for Indian and Woolwich appointments, the age of competition has been reduced to 18 (or rather, under 19), thereby throwing the greatest strain on the age least able to bear it, when the growth is most rapid, when the seeds of life-long infirmity are most easily sown.

Some one may say, are not physical competitions equally bad? Yes, I answer; they would be so if you were to give enormous money prizes for mile races open to boys under 14, and for three mile races open under 19. As it is, the longest race I know of open to boys under 14 is 300 yards, and to older boys it is one mile. And no boy should run mile or perhaps quarter mile races without medical leave, or if growing very quickly. But no such precautions are taken about our intellectual races. The prizes are not only big, but the competitors feel that their success in life depends on gaining them. They enter the contest not only with brain prematurely forced, but with blood insufficiently aërated by exercise, with cheeks unduly paled and chest unduly narrowed by sedentary work, often for ten or more hours daily, and with nerves unduly stimulated by the unnatural strain.

One effort was made to alleviate the evils of this system, and it was baulked.

Some years ago a Royal Commission reported in favour of giving marks for physical accomplishments, such as rowing, gymnastics, leaping, and running, in the case of candidates for army appointments. The standard for full marks in any case was not high. The total marks attainable were only equal to what might be gained by judicious cram about English literature. No premium would have been put upon excessive athletics, but candidates would have had some inducement to keep in a healthy condition by moderate exercise, and their life as well as their knowledge would have become the care of their tutors.

But the scheme was rejected by the supreme officials. Once or twice Lord Bury and others have raised a languid debate in Parliament, but unfortunately subjects affecting the healthy life, and not merely the healthy surroundings, of any class of the people do not as yet interest that assembly, and will not do so until they interest the nation.

The system of competitive examination has had free swing in

China for centuries. It has given her the mandarin. The selection of warriors by paper work, tempered by a previous London life partly sedentary and partly loose, is a climax which has been reserved for our riper civilisation.*

Time forbids my showing in detail how the tendency towards examinations and multiplicity of subjects has caused the health point of view to be put out of sight in other departments of education. But let me ask, with some diffidence, whether an unnecessary strain is not put upon medical students? Is all the technical knowledge which is exacted from them in chemistry, botany, and natural history, knowledge of a kind which they must or can always keep at their finger's end? or is there not much of it as to which the most skilled practitioners never trust their memories, but invariably use books of reference? And with respect to the Arts curriculum, was it necessary to add to it the formal study of English? I think that a great deal of nonsense has been talked upon this subject. The chief object of studying English is to learn to speak and write English, and this object was previously attained by translation from other languages, and by writing answers and essays in the philosophy classes, and all the great English speakers and writers have been trained without such formal study. We cannot live without water, but if we have plenty of milk and succulent diet, we don't require to drink water by itself. But if English must be a subject explicitly and not implicitly examined on for a degree in arts, surely, from the health point of view, it would be better to make it an alternative subject with Greek or Logic, than having it from 4 to 5 P.M., to make games or country rambles an impossibility for the students.

The same tendency to teach all subjects separately, and the same mistaken notion that all the information which we may have to use in life, ought to be stored away in the mind, at school or college, are the sources of inordinately long school hours throughout the country, and of many muddled brains. Just to illustrate what I mean. If any of you wished to be sure of the position of some cape in Africa, would you trust to school recollection, or would you look at a map? But it is surely better that children should leave school less well-informed, than that they should have

* And *vide* extract in Appendix on physical qualifications of civil servants.

an enfeebled body and brain. I have in my possession the time-table of a large and expensive English school for boys from 7 to 14, in which the hours of work for three days weekly, besides two compulsory chapels, amount to eight hours and fifty-five minutes. And I am assured, that at several of the great schools, owing to pressure of subjects, for three days in the week boys get no exercise worth the name.

Well, I fear that, acting on the shoemaker's principle, that there's nothing like leather, I have troubled you at inordinate length on the subject of education.

I have so far been attacking the mountain of indifference with a pickaxe, and I shall not occupy much time in the still more futile task of battering the shifting sand hills of fashion with the artillery of reason.

Ladies and Gentlemen, you need not be afraid, especially the ladies. I am not going to bring a skeleton out of a cupboard, or a torso from a museum, and compare nature and art with the help of a dressmaker's model hired for the occasion. Nor shall I prove the case against the fashionable boot, male or female, or the less guilty plebeian boot, for it has been proved a hundred times over by demonstration as rigorous as that of Euclid, how high heels disturb the balance of the figure, how narrow heels increase the chance of sprains, how cramming the toes together produces minor ailments, and how, above all, causing the joints of the great toe to work round a corner, instead of in a straight line, affects the whole mechanism of the foot and leg, and if it does no appreciable damage in youth, injures the power of locomotion in later life.

But let me tell you of what has been done at Lexington in America. It is a school of 300 girls, of the average age of seventeen, largely from wealthy families, deformed and made delicate by a fashionable life more unwholesome than our own. The constant dress at Lexington is short and loose, leaving the girls as much liberty as boys have, in what I think the best of all school dresses, the cricket dress. The gymnastic work is hard, the games and dancing vigorous, and the intellectual results, without over-pressure, are extraordinary. "What a slave I was," exclaims a pupil, "I have now just begun to live."

You may find a full account in *Health*, for June 15, 1883, and in the *Journal of Education* for, I think, the same month.

Some will say—But surely fashion is progressive. I fear not. The instinct of self-inflicted deformity and self-torture is found in all barbarous tribes; it is closely allied with moral evil, and it is one of the most serious difficulties of the Darwinian theory that not a trace of it is to be found in the lower animals. It would, in fact, handicap the self-injuring animal in the struggle for existence. Hence even if a bad fashion has been got rid of for a time, there is a tendency to periodical reversion "to type" not of the brute but of the self-injuring human ancestor. Let me give you an illustration.

At the beginning of this century the necks of men were enveloped in numerous folds of neckloth, and consequently the old gentlemen of that period died in large numbers of throat complaints. Things got better. The tie was worn only twice round, then once. But still walls of starched linen encumbered the free movement of the throat. Men of my age will remember the year of emancipation, about 1855. And I may surely assume that reason is all on the side of the throat being free.

The great preacher Mr Spurgeon says in his lecture to students: "Take care of your throat by never wrapping it up tightly. If any of you possess delightfully warm woollen comforters, with which may be associated the most tender remembrances of mother or sister, treasure them in the bottom of your trunk, but do not expose them to any vulgar use by wrapping them round your necks. If any brother wants to die of influenza, let him wear a warm scarf round his neck, and then one of these nights he will forget it and catch such a cold as will last him the rest of his natural life. You seldom see a sailor wrap his neck up. No; he always keeps it bare and exposed, and has a turn-down collar; and if he has a tie at all it is but a small one loosely tied, so that the wind can blow all round his neck. In this philosophy I am a firm believer, having never deviated from it for these fourteen years, and having before that time been frequently troubled with colds, but very seldom since. If you feel that you want something else, why, then, grow your beards! a habit most natural, scriptural, manly, and beneficial."

Now you all know what has happened within the last year or two. Phenomena like those of which the "masher" is the extreme development are interesting to the naturalist. They show reversion to an ancestral type, but not to that of any animal. Animals are not such fools. What elephant ever stuck pins into its trunk? What "beast that wants discourse of reason" ever tried to look as if it was throttling itself?

But you may say, If people oppose fashion are they not eccentric? Well, there are two kinds of eccentricity—the eccentricity of affectation, and the eccentricity of purpose. It is of the latter kind that John Stuart Mill says, "Eccentricity has always abounded when and where strength of character has abounded." Old Jonas Hanway, the first man who dared, in spite of the jeers of street boys, to carry an umbrella in London, was a much wiser man than the fools who laughed at him. He was the originator of many sanitary reforms.

If we can conceive a rational age looking back upon the present, what will it say to the mass of woollen clothing with which men encumber themselves in hot climates. There is a well-known picture in missionary journals of a man in solemn black addressing a group of natives in cool white garments. The sanitary missionary should be represented in a single ply of loose white flannel preaching to a group of Europeans in costumes which would pass muster at a Government House. Settlers dress sensibly. True; but when ladies come, men are supposed to be bound to pay them the doubtful compliment of incurring serious discomfort, and increasing the risk of fever by wearing more plies of clothing than they require, though English women are not in this respect as sensitive as the Russian ladies who pulled down their blinds because some Englishmen took off their coats to play lawn-tennis.

The *Lancet*, during a rarely hot summer, once said that the physicians of London would do more good by setting the example of dressing in loose flannel raiment than they could do in any other way. It was a courageous opinion. The physician of the future city will not tell us that clothing should be absolutely loose, of open texture, washable, and frequently washed—even in the clean city of the future—and of light colour, and in respect of

thickness and number of plies adapted entirely to the heat economy of the body, and at the same time dress himself in all climates in well-fitting dark garments of close texture. But I fear that though a few streaks of dawn may be visible, more perhaps in America than in this country, the day is not near at hand. We may indeed be cleansed from the leprosy of conventional opinion, but we must all of us yet awhile worship in the house of the Rimmom of custom, much as some of us might like to dash its graven images to the ground. But what of the claims of grace and beauty? I think that the ingenuity of the future may possibly invent something which shall satisfy the demands of truth and reason, and yet not fall far short in beauty of colour and of form of modern male costume.

There is, however, one matter of pressing, yes, even of pecuniary importance. The modern soldier is an expensive article. Do we wish to save money as well as life? What says science? The dress should be so free as to permit the unconstrained movement of every limb, loose and porous in texture. Such a dress also, especially for persons who have sometimes to undergo great changes in temperature without a change of clothes, is demonstrably the best for the heat economy of the body.

The head dress should be as light as what is called the deer-stalker, and in hot climates, a pith hat. The feet, I need hardly say, should be scientifically clad. An army so attired, if also provided with play-fields as well as gymnasia at all military stations, would pay for the cost of play-fields by decreased sickness and mortality, and would march round any army in Europe.

Now what says military custom?

In our last great war, the Crimean, the sea-sick troops, in narrow transports, had first to excoriate their chins in depriving themselves of the natural protectors of their throats. They were landed without tents and without waterproofs, exposed all night to torrents of rain, in tight clothes of that close texture which strikes a deadly chill when soaked, and dries most slowly, and then on the hot march which followed, men fell out, literally throttled by tight black stocks, worse than any masher's collar, while cholera all the time, aided by military stupidity, grimly revelled in her dance of death. And Dr Cathcart told you last

year, how this matter of clothing was put to a practical test in the Egyptian war. Two bodies, nearly equal in number, one of sailors, another of soldiers, accomplished the same march under a blazing sun. Of the soldiers, more than 100 fell out; of the loosely clad sailors, not a single man.

And have any of you ever seen, as I have, a squadron of recruits drilling, and swinging their arms in extension movements, in their close-fitting tunics? What drill instructor would ever suffer such a thing in a school? though I did hear of a school in England the other day, where, in spite of drill instructor, the master compelled the boys to do gymnastics in collars and waistcoats, lest they should catch cold.

I mentioned in my first lecture the excessive mortality from consumption among the Guards. It was largely due to bad ventilation. This was partially set right. But a large residuum remains, and it cannot be doubted that it is mainly due to the free movement of the mens' ribs and chests being obstructed by belts and close-fitting tunics. That free dressing increases the chest girth, and therefore the lung capacity, is, to my own mind, amply established by registers which I have carefully kept and averaged for more than nine years. But there is no time to enter upon this subject.

The evil influence of fashion is, I fear, not confined to dress. It affects the whole of life: the drinking customs of men of the lower, and, till lately, of the higher orders; the feeding customs by which people injure the digestion for life of their own, and, if they get the chance, of other people's children, and which, I fear, often tempt children of larger growth to waste what they have, and sometimes to spend what they have not in the absurd dinners and other feasts of a society which is rivalling many of the worst features of the Roman Empire; the funeral customs, which foster disease by artificially fostering depression, when the vital energies are already lowered by grief, which often take the bread out of the widow's and children's mouths to pay for crape and other black habiliments of woe, which prescribe inaction when air and exercise and employment are most necessary, which even shut out the light of heaven further to blanch the mourner's cheek, and to deepen the mourner's gloom. It affects not only

these, but in every circumstance of life this heartless and unreasoning tyrant still holds civilized man in slavery, and more even than indifference, clogs the advancing wheels of Health Reform.

What, then, is the remedy for these things?

What is the remedy for all evil?

Reverent obedience to the will and laws of God.

Such reverence and such obedience should be made part of a child's habits and nature from the first dawn of intelligence; they should be an essential part of the training of school; they should be constantly instilled from every pulpit. We should teach them, as the Jews of old were told to teach what was then known of God's laws, "diligently to thy children, when thou sittest in thy house, when thou walkest by the way, when thou liest down, and when thou risest up."

But what of our schools?

Miss Phœbe Blyth said lately at Galashiels, that the "Instruction" Act should be called the "Information" Act. I have a further count against it. The teaching which it prescribes informs where it should educate, but it does not inform where it should. The knowledge of how to live our lives is conspicuous by its absence from education. The child leaves Board schools, and many other schools, with scarcely a scrap of that information which should be so early and deeply engrained as to become an integral part of its mental habits and constitution. A child usually learns nothing at school about the air it breathes, nothing of the principles of ventilation, which indeed are grossly violated in a vast majority of sleeping rooms and school-rooms in which children live, or of the cleansing away of impurity and infection by the best of all disinfectants—fresh air: it learns nothing about food, not even the practical lesson (suggested by the *Spectator*)—and surely this would be a better use of part of our vast educational endowments than the institution of baby scholarships—of a daily meal of porridge and milk for ill-fed children: it learns no reason why it should not eat trash, or eat fast, or eat between meals, if well fed at meals; no reason why tea and white bread will not nourish it as well as the diet on which its forefathers throve; nothing about the preparation of food, an early neglect which causes almost as much good nourishment to

be wasted as is used throughout the country; nothing about the functions and necessity of exercise, which is treated mainly as an amusement, and which, owing to a sentimental clamour against the rod, is too often forfeited as a punishment; nothing about clothing, why it is better to sit in bare feet than in wet boots, why muffling the throat, as is now being done, without remonstrance from their teachers, by the poorer class of boys throughout Scotland, weakens the throat, and why the compression or distortion of any part of the person is not only an implied blasphemy against our Maker, but an injury to ourselves. It may learn science, but it is the rote and unpractised science of the text books; it may learn names of places which leave no useful or permanent impression on the mind; details and pat criticisms about authors, whose works it has never read; the bare outline and possibly the romance of past history, but nothing of the true work or the urgent needs of the present age. It may have offered to it possibly the dry bones of religion, unbreathed upon by that spirit which alone can make these dry bones live, without any reference to the laws which our Creator has ordained to govern the life, and minister to the happiness of His noblest handiwork.

Some of you must know the great inspiring words of the author of "Ecce Homo." They seem to me to embody an essential corollary of Christianity, and to be fraught with a truth and a power equal to that of any words ever penned by man: "Christ commanded his first followers to heal the sick and give alms, but he commands the Christians of this age, if we may use the expression, to investigate the causes of all physical evil, to master the science of health, to consider the question of education with a view to health, the question of labour with a view to health, the question of trade with a view to health; and while all these investigations are made with free expense of energy and time and means, to work out the rearrangement of human life in accordance with the results they give."

There is now no longer the excuse of ignorance. Surely to all of us, as once to the idol-worshipping, but no longer idol-reverencing Athenians, the voice sounds loudly:

"The times of this ignorance God winked at, but now commandeth he all men everywhere to repent."

APPENDIX.

HEALTH AND COMPETITIVE EXAMINATIONS.

(*To the Editor of the "Times."*)

SIR,—I read on page seven of your issue of to-day an elaborate paper read at the Social Science Congress by the President of the Health Department. Your correspondent says the President "availed himself of the opportunity of giving utterance to thoughts which had forced themselves upon him as a medical man, as a professional teacher, as a university examiner," in reference to the tendency of modern education to influence health and physical growth and development. The President said, "Competition had become a plague spot." He pointed out that there is competition for the services, for college scholarships, for public school scholarships, and that in the last there is "severe competition among boys little above childhood." He said, "The successful boy must bear the strain till he breaks down, or till he began the work of life an exhausted man;" that "a warning note had come from India on premature failure of health, exhausted faculties, and shattered nervous systems;" that Sir A. Clark asserts that "of the young men who win appointments in India more than one-tenth become albuminuric;" that Dr Browne says, "The future of the race constrains all medical men to preach the wisdom of caution, and the danger of brain-forcing, and to impress on parents and teachers that to overwork the miniature brain is to enfeeble it." His conclusion was that he "saw injury to health, degradation of intellect, and a departure from a true ideal of education, because we are importing (he might have said "have imported") into modern education hurry, worry, anxiety, selfishness, competition, and feverish desire for success, prize-winning, place-winning, and mark-winning, all tending year by year to grow in intensity and to become more powerful agents."

This is all right enough, and might have been made much stronger. There seems to me a little confusion of thought, because a desire for success is not a crime, or, indeed, anything but a good thing. Prize-winning, too, is not a bad thing in itself, and not necessarily the same thing as "brain-forcing." Sir A. Clark has won the prizes of his profession. Competition and place-winning are always going on among the leaders of men in all lines of life, and there are rivals for the "place" of Prime Minister and Lord Chancellor, as well as for appointments in Her Majesty's Civil and Military services, for school and university and college scholarships, and for "a first" in the University Class-lists. Where there is competition and rivalry, there must be some selfishness

and some anxiety, however little. It is the "hurry" and the "worry" which does the mischief. One of my earliest recollections is how Kirke White virtually killed himself by overwork and anxiety in competing for the blue ribbon of the year at Cambridge—to be Senior Wrangler. There is a well-known case at Cambridge of a man who read twelve hours a day for three and a half years to get "a double first"—got it, never recovered from the strain, and ultimately committed suicide. There are doubtless many other cases, both at Oxford and Cambridge, which could be quoted; but I never heard that anyone wanted to abolish the Classical and Mathematical Triposes at either Oxford or Cambridge because of them. And why? Because the cases are so few. Similarly, we never hear any of those sad stories about young men who have won appointments in the Home Civil Service. The reason is plain. Most young men did not injure themselves reading for university honours, because they did not compete till, say, twenty-three years of age. Similarly, candidates for the home Civil Service can compete up to twenty-four. The President of the Health section made a point when he drew attention to the fact that "the marvellous opening out of the field of natural science compelled the universities to widen their borders and give the younger science a place beside the elder sisters." He might have added that whereas, not so very many years ago, there were only classical and mathematical class lists at Oxford and Cambridge (the Classical and Mathematical Triposes), there are now law, history, moral science triposes, as well as for "natural science." As there is more to do for an earnest student, you might have expected that a little more time would be allowed. In bygone days men went up to Cambridge occasionally at twenty-four and twenty-five, and sometimes even older. The best instance I remember is Mr Todhunter. He, not choosing to be hurried, did not go up until older than most men when they take their degrees. Then the theory was started that such cases defrauded really cleverer though younger competitors, and a rule was made in some colleges that candidates for College Scholarships must be "under twenty years of age." And quite lately the age has been cut down to nineteen. The best men, therefore, must either go without scholarship (which very few like to do, or will afford to do if they can help it), or take their degrees at latest when they are twenty-three. Hence it appears that the cleverest and sharpest and most promising little boys are carefully coached for Public School Foundation Scholarships, for which they must be "under fourteen,"—are then carefully coached for College Scholarships, for which they must be "under nineteen,"—and are then carefully coached for their degrees in honours, which they take (or miss) when "under twenty-three." The worst of this is that you risk

ruining the best intellect. It has always been known that the reputation of Eton has been kept up for years by the Foundation Scholars, who were carefully coached and looked after, sixty or seventy in number. The other 600 or 700 picked up what they could. Hence some of those who were luckily for them ignored have come out the best. I have known more than one case of brain failure during the last quarter of a century among the Fellows of King's. I have heard of no cases among the successful competitors for the Home C. S. They compete up to twenty-four. Candidates for the India Civil Service originally could compete up to twenty-three. There were no "albuminurics" then. But there were what the aristocracy thinks worse—viz., clever young men of lowly birth who, having time before them to do it in, studied their subjects alone or with such help as they could get, and won the prize. I knew a school "usher" who got one. A chemist's shopman got one. This was intolerable. The high born aristocrats of Haileybury pronounced them "socially unfit" for the service. And as they could not keep them out any other way, the age was lowered. Candidates were to be "over seventeen, under twenty-one." Allowing boys of seventeen to compete did a lot of mischief, and accounts for the "albuminurics," "premature failing of health, exhausted faculties, and shattered nervous systems." But even that did not stop the "socially unfit" men. If allowed to compete up to twenty-one, some could get in. So the age was lowered again, and candidates must now be "over seventeen, under nineteen." There will soon be a far larger number of albuminurics, and more ruined health and shattered systems. Similarly with the engineers and artillery. When the Crimean war broke out, or was breaking out, officers were wanted. Commissions in the "Scientific Branches" were thrown open to public competition. Candidates could compete up to (I think) twenty-two. Young men who meant to live on their pay jumped at this chance. In the very first competition a scholar of my own college succeeded. Some of the "socially unfit" class got in, and they have cut down the age at which candidates can compete for Woolwich to "over sixteen, under eighteen."

The remedy is plain enough. Raise the age. The more you cut down the limit of age, the more cramming, brain-forcing, pressure, &c., and the more ruined health and shattered systems will you have. Not long ago I heard a distinguished M.P., who ought to have known better, say, "the standard should be lowered." You cannot lower the standard. So long as there is any competition, the boys will keep the standard up. Lower the age to twelve, and examine them on the Lord's Prayer, and nothing else, and there is room for good teaching, as well as for cramming and brain-forcing. The cutting down of the

age has done the mischief, and will do more. The more you cut down the age the more severe will be the competition and the worse the breakdowns. We have reached the climax of folly. Boys under fourteen who compete for Public School Scholarships are examined in nine or ten subjects—viz., in English—in (1) religious knowledge, (2) geography, (3) English history, (4) dictation; in languages—in (5) Latin, (6) Greek, (7) French, grammar and translations, and also in (8) Latin prose and (9) Latin verse composition; in mathematics—in (10) arithmetic, (11) algebra, (12) euclid, and lastly, handwriting.

There is room for plenty of breakdowns here. "Religious knowledge" is a middling wide field. You cannot put a quart of beer into a pint pot. You cannot put five years' work into three. Still less can you put fifteen years' work into nine. You cannot make babies do boys' work. And you cannot make boys with immature brains do young men's work without injuring those brains, and, mark, the brains always give way before the physical health suffers. If you put too many irons into the fire of a boy's mind, and keep on blowing at that fire to see whether you can keep all those irons hot, you will very soon burn that fire right away to dust and ashes. This has been done in many cases. The longer you keep the age down, the more there will be.—Your faithful servant, WALTER WREN.

7 POWIS SQUARE, W., *October* 9, 1883.

EDUCATIONAL OVER-PRESSURE.

(*The Morning Post*, *Friday*, *October* 12, 1883.)

THERE is evidently a good time in store for the spectacle makers in this country, for we have firmly determined to follow the example of Germany, and introduce short-sightedness on a large scale amongst our children. We have decided in favour of mental muddle as against clear vision; and, by means of excessive bookwork in schools, and the severe strain on the muscles of accommodation and the increased tension of the eyeball thereby occasioned, we are already reaping a rich harvest of myopia. It is, of course, difficult for modern ophthalmic surgeons accurately to compare their results with those of their predecessors, who were unprovided with the delicate tests now in use for the detection of errors of sight; but the conclusions they have arrived at cannot, alas! be shaken by the supposition that they are merely bringing to light defects which formerly escaped detection. The present number of grave cases of failure of vision, such as must at any period have secured recognition, is vastly in excess of anything that we find recorded by the authorities of past times, while the multiplication of minor visual impairments is going on under the immediate observa-

tion of living authorities in a manner that admits of no dispute. All English ophthalmologists are agreed that myopia is becoming daily more frequent amongst us ; and Mr Badderch Hewetson and Mr Edgar Browne made it abundantly clear, at the meeting of the Social Science Association at Huddersfield on the 4th inst., that this increased prevalence of myopia is attributable to school-work and over-employment of the eyes on print by children and young persons. The strain of the eyes in reading and fine sewing required of children now to bring them up to the standards which they have to pass results in deformity of these organs, which is more especially apt to occur when there is an inherited tendency to it, where general bodily nutrition is faulty, or where the construction of the school furniture and distribution of the light are faulty. Now these facts as to the spread of short-sightedness amongst the young are alone sufficient to prove that educational over-pressure exists, and in view of them it is in vain for members and officials of school boards, who seem all to assume a pedagogic infallibility of tone, to asseverate that the present system is doing no harm, and that the doctors are simply foolish alarmists because they suggest that it is. If education, as now conducted, is causing wholesale short-sightedness, it ought to be overhauled and amended without delay, for, in homely phrase, "the game is not worth the candle," and an elementary knowledge of reading, writing, and arithmetic is dearly purchased by the partial blocking up of one of the great gateways of knowledge, which ought to remain the principal inlet of edification and delight all through life. But these defects of vision which have been alluded to do not exhaust the indictment against education in these days. Worse remains behind. The children whose eyes fail them, and who go on groping over their relentless task in dimness and confusion, complain of headaches, and hundreds of other children whose sight remains good also experience frequent pains in the forehead or vertex. In a certain proportion of these cases the headaches are relieved by the use of appropriate glasses, but in a large number they persist in spite of all ophthalmological efforts, and are shown to depend on a state of irritation of the brain. And it is scarcely to be wondered at that the brain should suffer from processes which leave their pernicious impress on the eye. The eye is a delicate organ, but, compared with the brain, it is what a ship's cable is to a cobweb, and it is certain that any operations in which they are both engaged that are detrimental to the one will be tenfold more detrimental to the other. We really wish that our educationalists, who habitually talk of the brain as if it were a hard and stony structure that will stand any amount of chiselling and polishing, could see a microscopic section of a shred of it. Looking at a group of its starry cells, with their innumerable branches

lying in their neuroglia, "like a swarm of fire-flies tangled in a silver braid," tracing out its intricate conduits and interlacing strands, learning that this exquisite complexity of tissue when alive is of the consistence of red-currant jelly, and that the "living splendour" with which it is "burnished"—its functional activity—is something as impalpable as the bloom on a ripe plum, which can be brushed off with a touch, and can never be reproduced, they would be more chary thereafter in imposing burdens on it, and in wearing it out prematurely by vexing toil. They would realise that if educational over-pressure impairs the power of the eye and alters its shape, it is likely to induce still more serious consequences in that supreme centre of which the eye is but the minister. And the real truth would seem to be that excessive application to study in early years does set up a sort of intellectual short-sightedness, analogous to visual short-sightedness, but much more difficult to discover and measure. We know that, in extreme cases, hopeless imbecility has been induced by the ruthless brain-forcing of children; and we are entitled to infer that in a much larger number of cases artificial stupidity or a blunting of the fine edge of talent has followed it in those who have schooled "not wisely, but too well." The zealous teacher, with an eye to payment by results, gets results where he should only aim at preliminaries, and finishes up at twelve the evolution of a mind that ought to have gone on till middle life. The school headaches which we have adverted to, and which are attracting anxious attention in Germany, are very significant of hidden mischief and of the risks we are running. Headaches used to be utterly unknown in children in this country, except as a premonitory of acute hydrocephalus or as a symptomatic of organic disease of the brain; and now they are of the commonest occurrence amongst town children, many of whom bring them home with them from school every day, while others suffer from them now and again, or when the home work has been exceptionally heavy. But these school headaches betoken an irritated condition of the cerebrum and its membranes, and that they do so is shown by the fact that they occasionally run on into tubercular meningitis. Even, however, when they do not overstep the boundary of common headache, they are full of danger and well calculated to excite forebodings, for the young brain cannot be irritated with impunity, and the headachy child is only too likely to grow up into the dissolute or insane man or the hysterical woman. And not less significant than the school headaches of some children in these days are the school twitchings of others. Grimacings, startings, and choreic movements of one kind or another are prevalent amongst school children of the more affluent classes, and particularly amongst girls, to an extent that could not be

surmised by those who had not made observations on the subject, and that is ominous of disaster. Medical men are, and ever have been, the consistent advocates of education. None knew so well as they the hygienic value of training and development of knowledge, intellectual resources, and self-control. But what they desire is education in its larger sense and not mere schooling. Without under estimating the utility of the schoolmaster, it must be maintained that the least important part of education is that which is obtained under his auspices. He cultivates a corner of human life, and makes it yield useful produce ; but its wide expanse teems with luxuriant and varied growth that he has never evoked, but that he may do much to blight and stunt. All nature—sky, earth, flood, field, and flower—all the forces of the universe—the stars in their courses, the summer lightning, the winter's frost, the dancing atoms, the mysteries of hate and love—are ceaselessly busy in teaching the child ; and shall we allow a dull man with a ferule in his hand to take the credit of the result? If we do, and, accepting his exaggerated notions of his own mission, permit him to encroach too largely on the domain of the primordial teachers, pinning infants to benches when they should be roaming free, stuffing them with grammar when they should be quaffing sunshine, we, or those who come after us, will bitterly repent it. We shall become an island full of round-backed, blear-eyed bookworms, poor of heart and small of soul, instead of a nation of men and women strong of limb, graceful in movement, nimble-handed, quick-sighted, clear-headed, tender, and true—a nation such as we should all wish the English to become. The penalties of educational over-pressure of every kind fall much more heavily on the children in urban than in rural districts. Their nervous systems are more unstable to begin with, and they lack the benefit of those mighty correctives—fresh air, sunlight, and freedom—which country children enjoy. But on children of all classes the rage for precocity which animates those who have the regulation of educational methods is telling more or less. The screw is applied too severely, and it is applied far too fast. It should have been remembered that the great mass of children gathered or driven into board schools have no inherited aptitude for learning, and can only crawl painfully along the path that better-born children tread lightly. If it takes three generations to make a gentleman, it takes at least half a dozen to make a scholar ; and to force sickly and underfed children, handicapped by a load of inherited pathological tendencies, to keep pace with the strong, the well-nourished, the soundly constituted, is both cruel and wasteful. School boards had better rouse themselves to a sense of the true situation at once ; if they do not, they will be awakened to it by the voice of the country in somewhat peremptory and ungracious tones before long.—*Medical Times.*

PHYSICAL QUALIFICATIONS OF CIVIL SERVANTS.

From "Madras Weekly Mail," 19th Dec. 1883.

A Bombay contemporary has found the following despatch, dated 8th August 1882, from Bombay Government to the Secretary of State for India, in the last report of Her Majesty's Civil Service Commissioners:—

My Lord Marquis,—We have the honour to acknowledge the receipt of your Lordship's public despatch No. 4, dated 27th April 1882, in paragraph four of which your Lordship desires, with reference to the observations made in our political letter No. 5, dated 31st January last, on the importance of constitutional robustness in the case of young men selected for the Civil Service, to be furnished with full particulars respecting the cases to which those observations relate, including the date of arrival in India.

In reply, we have the honour of forwarding the accompanying list, furnishing, as fully as we can, the information called for by your Lordship, and to state that in our opinion the list shews that too many gentlemen have been sent out who were not sufficiently robust to stand the work, and that, considering the great advantages of the Civil Service, Government have a right to expect that the candidates possess the physical strength without which they cannot efficiently perform their duties.

We beg to add that of three covenanted civil servants lately transferred to this presidency to meet a deficiency of civil officers, one, Mr ———, immediately on his transfer, applied for the full amount of privilege leave to which he was entitled, and supported his application by a medical certificate to the effect that he was "invariably suffering from affections of the liver, stomach," &c., and that his chief complaint at the time was "sleeplessness, violent headache, incapacity for work, great nervousness and general weakness." He was also certified by the head of his department in the Punjab to have "frequently been in ill-health."

We take this opportunity to state, for your Lordship's information, that instances have come to our knowledge of covenanted civil servants being quite unable to ride, though they must have, before they came out to India, furnished certificates of their having undergone a course of instruction in equitation. We have recently ordered such civilians to attend a course of instruction in riding schools, to the detriment of their proper duties. We beg leave, therefore, to suggest the expediency of certificates of equitation from responsible persons being insisted on in future in the case of civilians allotted to this presidency, before they are sent out to India.

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